TECHNICAL MANUAL

OPERATOR'S MANUAL FOR ARMY C-12R AIRCRAFT

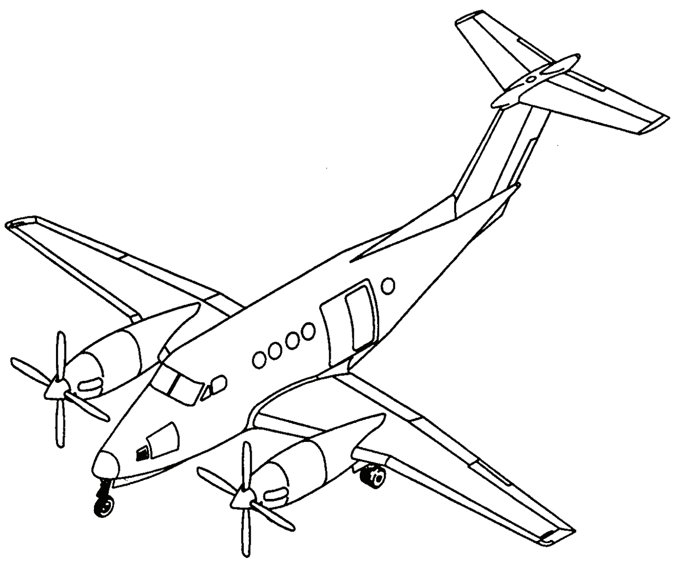
NSN 1510-01-425-1355

ARMY C-12T3 AIRCRAFT

NSN 1510-01-470-0220

ARMY C-12F3 AIRCRAFT

NSN 1510-01-235-5840



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This manual supersedes TM-1-1510-225-10, dated 4 September 2001

HEADQUARTERS DEPARTMENT OF THE ARMY

15 SEPTEMBER 2009

WARNING PAGE

Personnel performing operations, procedures, and practices that are included or implied in this technical manual shall observe the following warnings. Disregard of these warnings and precautionary information can cause serious injury or loss of life.

NOISE LEVELS

Sound pressure levels in this aircraft during some operating conditions exceed the Surgeon General's hearing conservation criteria, as defined in TB MED 501. Hearing protection devices, such as a headset or ear plugs, shall be worn by all personnel in and around the aircraft during its operation.

STARTING ENGINES

Operating procedures or practices defined in this technical manual must be followed correctly. Failure to do so may result in personal injury or loss of life.

Exposure to exhaust gases shall be avoided since exhaust gases are an irritant to eyes, skin, and respiratory system.

HIGH VOLTAGE

High voltage is a potential hazard around AC inverters, ignition exciter units, and strobe beacons.

USE OF FIRE EXTINGUISHERS IN CONFINED AREAS

Monobromotrifluoromethane (CF_3Br) is very volatile, but is not easily detected by its odor- Although non toxic, it must be considered to be about the same as other refrigerants and carbon dioxide, causing danger to personnel primarily by reduction of oxygen available for proper breathing. During operation of the fire extinguisher, ventilate personnel areas with fresh air. The liquid shall not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns because of its very low boiling point

VERTIGO

The strobe beacon lights should be turned off during flight through clouds to prevent sensations of vertigo, as a result of reflections of the light on the clouds.

CARBON MONOXIDE

When smoke, suspected carbon monoxide fumes, or symptoms of lack of oxygen (hypoxia) exist, all personnel shall immediately don oxygen masks, and activate the oxygen system.

FUEL AND OIL HANDLING

Turbine fuels and lubricating oils contain additives that are poisonous and readily absorbed through the skin. Do not allow them to remain on skin.

SERVICING AIRCRAFT

When conditions permit, the aircraft shall be positioned so that the wind will carry fuel vapors away from all possible sources of ignition. The fueling unit shall maintain a distance of 20 feet between unit and filler point. A minimum of 10 feet shall be maintained between fueling unit and aircraft. Prior to refueling, the hose nozzle static ground wire shall be attached to the grounding lugs.

SERVICING BATTERY

Improper service of the nickel-cadmium battery is dangerous and may result in both bodily injury and equipment damage. The battery shall be serviced in accordance with applicable manuals by qualified personnel only.

Battery electrolyte (potassium hydroxide) is corrosive. Wear rubber gloves, apron, and face shield when handling batteries. If potassium hydroxide is spilled on clothing, or other material, wash immediately with clean water. If spilled on personnel, immediately start flushing the affected area with clean water. Continue washing until medical assistance arrives.

JET BLAST

Occasionally, during starting, excess fuel accumulation in the combustion chamber causes flames to be blown from the exhausts. This area shall be clear of personnel and flammable materials.

RADIOACTIVE MATERIAL

Instruments contained in this aircraft may contain radioactive material (TB 55-1510-314-25). These items present no radiation hazard to personnel unless seal has been broken due to aging or has accidentally been broken. If seal is suspected to have been broken, notify Radioactive Protective Officer.

RF BURNS

Do not stand near the antennas when they are transmitting.

OPERATION OF AIRCRAFT ON GROUND

Engines shall be started and operated only by authorized personnel. Reference AR 95-1. LCCS Contractor personnel are authorized IAW the Contract and Statement of Work. Ensure that landing gear control handle is in the DN position.

INSERT LATEST CHANGE PAGES. DESTROY SUPERSEDED PAGES.

LIST OF EFFECTIVE PAGES

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Dates of issue for original and change pages are:

Original . . . . . 0 . . . . . 15 SEPTEMBER 2009

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 902, CONSISTING OF THE FOLLOWING:

Page No.	*Change No.	Page No.	*Change No.
Title	0	9-1 – 9-19	0
a – c	0	9-20 Blank	0
d Blank	0	A-1	0
A	0	A-2 Blank	0
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TECHNICAL MANUAL

NO. 1-1510-225-10

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC 15 September 2009

OPERATOR'S MANUAL FOR ARMY C-12R, C-12T3, AND C-12F3 AIRCRAFT

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) located in the back of this manual directly to: Program Executive Office-Aviation, ATTN: SFAE-AV-AS-FW, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also send your comments electronically to our e-mail address, troy.brown@redstone.army.mil or by fax 256-955-0887/DSN 645-0887.

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CHAPTER 1
INTRODUCTION

1-1. GENERAL.

These instructions are for use by the operators. They apply to the C-12R, C-12T3, and C-12F3 model aircraft.

1-2. WARNINGS, CAUTIONS, AND NOTES.

Warnings, cautions, and notes are used to emphasize important and critical instructions. Explanatory examples are as follows:

WARNING

An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, condition, or statement which, if not strictly observed, could result in damage to or destruction of equipment, loss of mission effectiveness, or long term health hazards to personnel.

NOTE

An operating procedure, condition, etc., which is essential to highlight.

1-3. DESCRIPTION.

This manual contains the best operating instructions and procedures for the C-12R, C-12T3, and C-12F3 aircraft under most circumstances. The observance of limitations, performance, and weight/balance data provided is mandatory. The observance of procedures is mandatory except when modification is required because of multiple emergencies, adverse weather, terrain, etc. Basic flight principles are not included. THIS MANUAL SHALL BE CARRIED IN THE AIRCRAFT DURING ALL FLIGHTS. Manuals printed from CD must be on standard 8 1/2 x 11 paper.

Users are authorized to remove the chapters that are not applicable to their aircraft model and are not required to carry those chapters on-board.

1-4. APPENDIX A, REFERENCES.

Appendix A is a listing of official publications, cited within this manual, which are applicable to and available for flight crews.

1-5. APPENDIX B, ABBREVIATIONS AND TERMS.

Appendix B is a listing of abbreviations and terms used throughout this manual.

1-6. INDEX.

The index lists, in alphabetical order, titled paragraphs, figures, and tables contained in this manual.

1-7. ARMY AVIATION SAFETY PROGRAM.

Reports necessary to comply with the safety program are prescribed in AR 385-40.

1-8. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE.

For information concerning destruction of Army materiel to prevent enemy use, refer to TM 750-244-1-5.

1-9. FORMS AND RECORDS.

Army aviators flight records and aircraft maintenance records which are to be used by crew members are prescribed in DA PAM 738-751 and weight and balance manual TM 55-1500-342-23.

1-10. EXPLANATION OF CHANGE SYMBOLS.

a. General. Change symbols show current changes only. Change symbols are not used to indicate changes in the following: introductory material; indexes and tabular data where the change cannot be identified; blank space resulting from the deletion of text, an illustration or a table; or correction of minor inaccuracies, such as spelling, punctuation, relocation of material, etc., unless correction changes the meaning of instructive information and procedures.

b. Text and Table Changes. Changes to text and tables, including new material on added pages, are indicated by a vertical line in the outer margin extending close to the entire area of the material affected.

c. Illustration Changes. A miniature pointing hand symbol is used to denote a change to an illustration. However, a vertical line in the outer margin, rather than miniature-pointing hands, is used when there have been extensive changes made to an illustration.

1-11. AIRCRAFT DESIGNATION SYSTEM.

a. The designation system prescribed by AR 70-50 is used in aircraft designations as follows:

b. Example C-12R:

C – Basic mission and type symbol (Cargo)

12 – Design number

R – Series symbol

1-12. AIRCRAFT EFFECTIVITY DESIGNATORS AND SERIALIZATION.

The aircraft effectivity for content within this manual will be designated by the following symbols. These symbols may be used individually or in groups.

R	All C-12R aircraft.
T3	Aircraft with serial numbers 84-0143 through 84-0182 or serial numbers 84-0484 through 84-0489 ***modified*** with the cockpit and digital engine instrument upgrade.
F3	Aircraft with serial numbers 84-0143 through 84-0182 or serial numbers 84-0484 through 84-0489 ***not modified*** with the cockpit and digital engine instrument upgrade.
OSA	Operational Support Airlift aircraft with serial numbers 84-0143 through 84-0182 issued from the U.S. Air Force.
ANG	Aircraft with serial numbers 84-0484 through 84-0489 issued from the Air National Guard.

The effectivity symbols listed are used in conjunction with paragraph titles, text content, performance charts and graphs, tables, figure titles, and specific items on illustrations to show proper effectivity of the material as applicable. If the material applies to all models within the manual, no effectivity designators are used. Where practical, to avoid duplication, descriptive information is written to apply to all models and split series effectivities.

1-13. USE OF WORDS SHALL, SHOULD, AND MAY.

Within this technical manual, the word "shall" is used to indicate a mandatory requirement. The word "should" is used to indicate a nonmandatory but preferred method of accomplishment. The word "may" is used to indicate an acceptable method of accomplishment.

1-14. PLACARD ITEMS.

Where applicable, placarded items (switches, controls, etc.) are shown, throughout this manual, in boldface capital letters.

1-15. AVIONICS CHAPTERS.

This manual contains five Avionics chapters entitled as follows:

Chapter 3 Avionics	— Avionics common to all C-12R, C-12T3, and C-12F3 Aircraft
Chapter 3A Avionics	— C-12R Aircraft
Chapter 3B Avionics	— C-12T3 Aircraft
Chapter 3C Avionics	— C-12F3 Aircraft
Chapter 3D Global Positioning System	— C-12R and C-12F3 Aircraft

1-16. NORMAL PROCEDURES.

This manual contains two Normal Procedures chapters entitled as follows:

Chapter 8 Normal Procedures	– C-12R Aircraft
Chapter 8A Normal Procedures	– C-12T3 and C-12F3 Aircraft

CHAPTER 2
AIRCRAFT AND SYSTEMS DESCRIPTIONS AND OPERATION

Section I. AIRCRAFT

2-1. INTRODUCTION.

The purpose of this chapter is to describe the aircraft and its systems and controls that contribute to the physical act of operating the aircraft. It does not contain descriptions of avionics or mission equipment covered elsewhere in this manual. This chapter also contains the emergency equipment installed. This chapter is not designed to provide instructions on the complete mechanical and electrical workings of the various systems; therefore, each is described only in enough detail to make comprehension of that system sufficiently complete to allow for safe and efficient operation.

2-2. GENERAL.

The C-12R, C-12T3, and C-12F3 are pressurized, low wing, all metal aircraft and are powered by two PT6A-42 turboprop engines. The aircraft has all-weather capability. Distinguishable features of the aircraft are the slender, streamlined engine nacelles, four-blade propellers, T-tail, and dual aft body strakes. The basic mission of the aircraft is to provide scheduled or unscheduled air transportation of passengers and / or cargo in any area of the world. Cabin entrance is made through a stair-type door aft of the wing on the left side of the fuselage. Refer to Figure 2-1, Sheets 1 through 6, for illustrations of the general exterior arrangement for C-12R, C-12T3, and C-12F3 aircraft.

2-3. DIMENSIONS.

Overall aircraft dimensions are shown in Figure 2-2.

2-4. GROUND TURNING RADIUS.

Minimum ground turning radius of the aircraft is shown in Figure 2-3.

2-5. MAXIMUM WEIGHTS.

a. Operations At Or Below 12,500 Pounds.

(1) Takeoff. Maximum Gross Takeoff Weight (GTOW) is 12,500 pounds.

(2) Landing. Maximum gross landing weight is 12,500 pounds.

(3) Maximum Ramp Weight. Maximum ramp weight is 12,590 pounds.

(4) Maximum Zero Fuel Weight. Maximum zero fuel weight is 11,000 pounds.

(5) Altitude.

(a) At least 75% of total missions shall be flown at altitudes above 5,000 feet above ground level when operating at or below 12,500 pounds GTOW.

(b) At least 50% of total missions shall be flown at altitudes above 10,000 feet above ground level when operating at or below 12,500 pounds GTOW.

b. Operations Over 12,500 Pounds Gross Takeoff Weight.

(1) Requirements.

WARNING

Artificial stall warning systems may only provide a 1 to 5 knot stall warning.

CAUTION

Maximum GTOW charts must be strictly followed in the event of an engine failure.

(a) Aircraft shall be equipped with Raisbeck Engineering dual aft body strakes and engine ram air recovery system with PT6A-42 engines.

(b) Landing. Maximum landing weight is 12,500 pounds, unless required by an emergency. If it is necessary to land with a weight over 12,500 pounds, the landing shall be made on a smooth, paved runway at a sink rate of 500 feet per minute or less, if possible.

(c) Altitude and Flight Duration. All missions with over 12,500 pounds GTOW shall be planned and flown at or above 10,000 feet above ground level and be a minimum of 60 minutes in

duration unless restricted by Air Traffic Control, turbulence, other weather conditions, or emergencies.

(d) Takeoff. All missions with over 12,500 pounds GTOW shall be flown on a smooth, paved runway. Takeoffs shall not be performed with a tailwind.

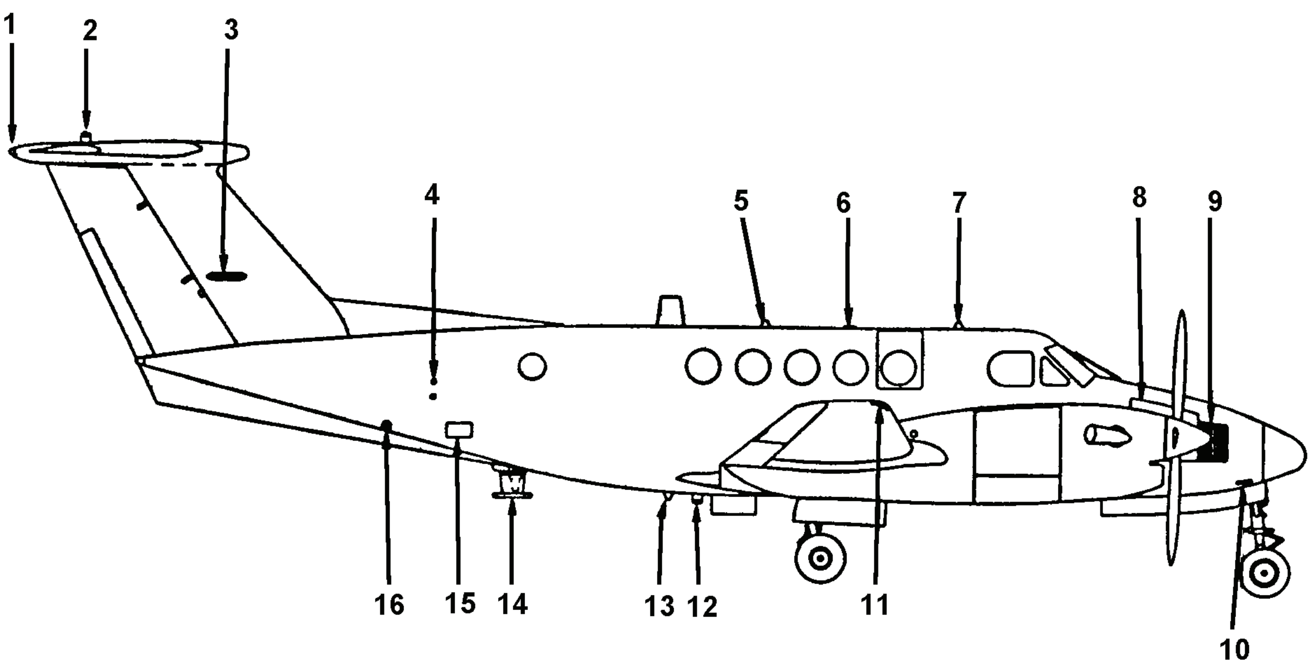
(2) Maximum Weight Operation.

(a) Takeoff. Maximum GTOW is 14,000 pounds.

(b) Landing. Maximum gross landing weight is 12,500 pounds.

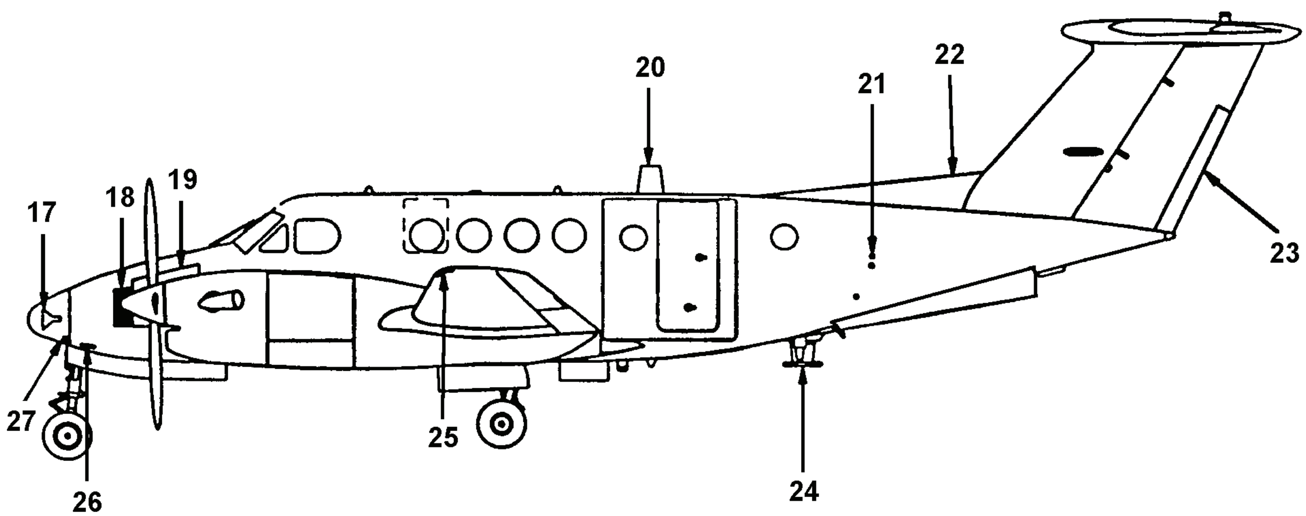
(c) Maximum Ramp Weight. Maximum ramp weight is 14,090 pounds.

(d) Maximum Zero Fuel Weight. Maximum zero fuel weight is 11,000 pounds.



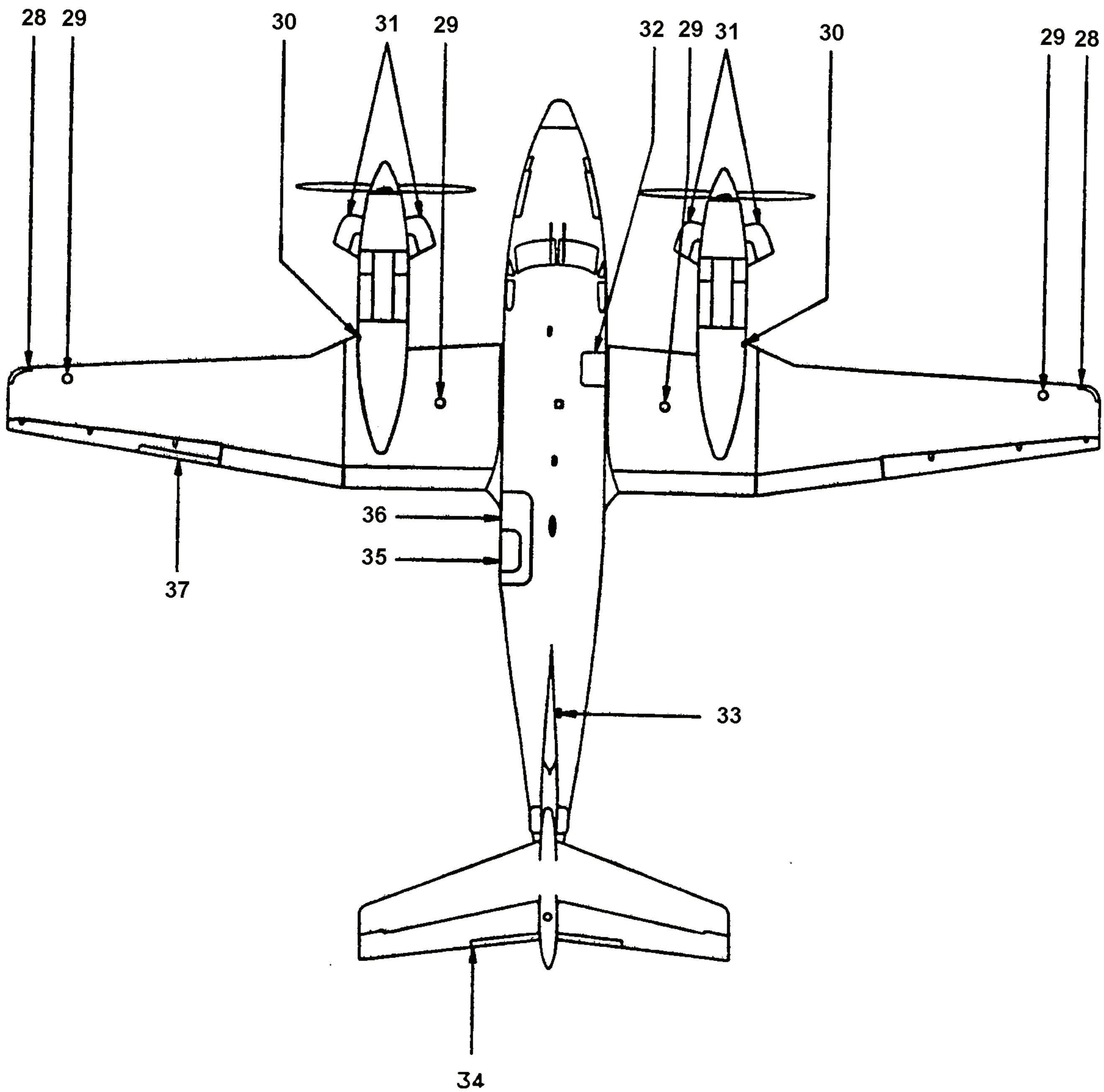
1. Tail Navigation Light
2. Strobe Beacon (Upper)
3. VOR / Localizer Antenna
4. Static Air Ports (Right)
5. Transponder Antenna
6. Global Positioning System Antenna
7. TACAN Antenna (Upper)
8. Nose Avionics Compartment Access Door
9. Air Conditioner Condenser Air Inlet
10. Pitot Tube (Right)
11. Navigation And Strobe Light
12. Strobe Beacon (Lower)
13. TACAN Antenna (Lower)
14. AM/FM (VHF/UHF) Communications Antenna
15. Oxygen System Servicing Door
16. Emergency Locator Transmitter Switch Access Door

Figure 2-1. General Exterior Arrangement – Right Side (Sheet 1 of 6)



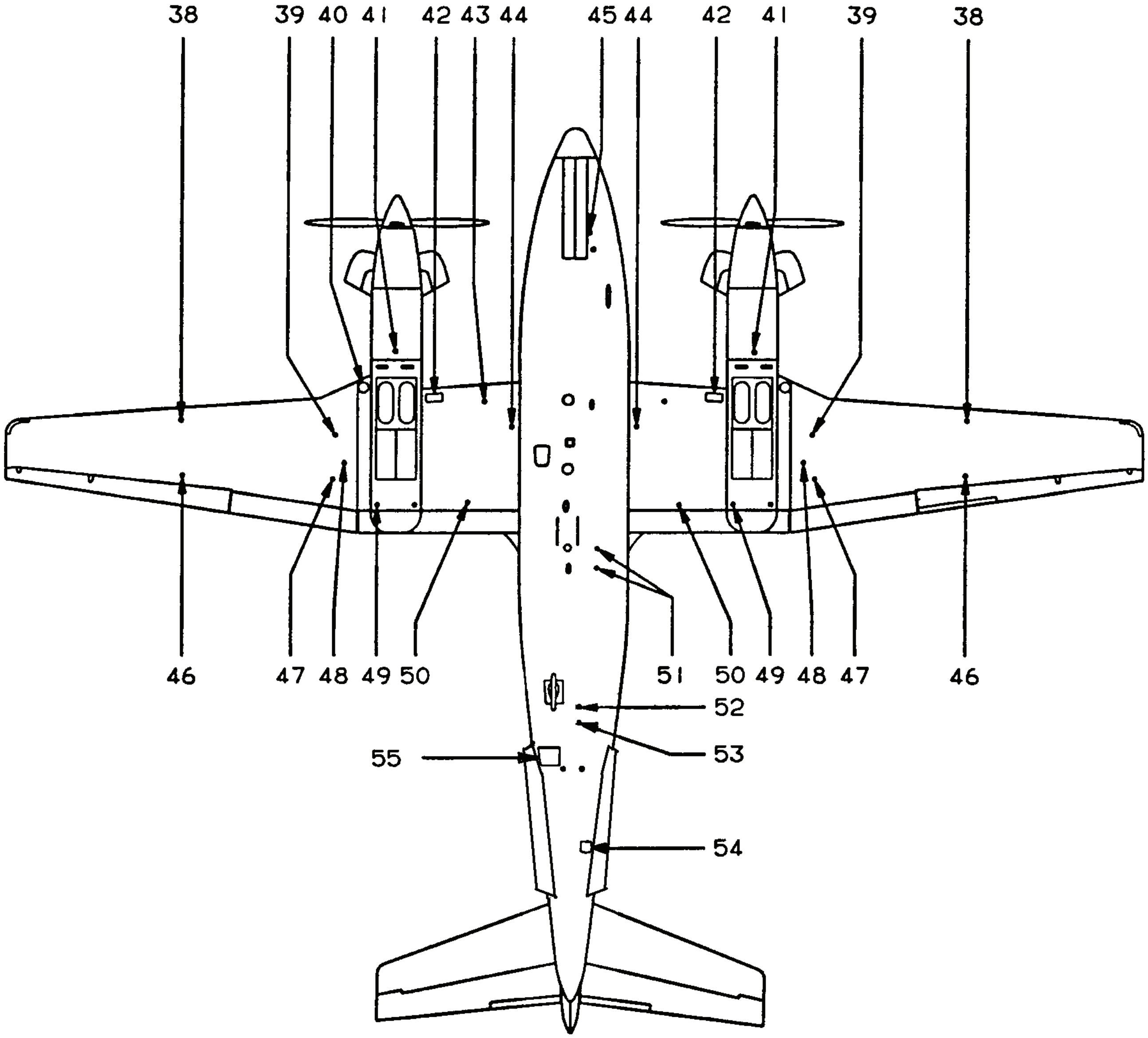
17. Radar Antenna
18. Air Conditioner Condenser Air Outlet
19. Nose Avionics Compartment Access Door
20. VHF / UHF Communications Antenna
21. Static Air Ports (Left)
22. Dorsal Fin
23. Rudder Trim Tab
24. UHF / Transponder Antenna
25. Navigation And Strobe Light
26. Pitot Tube (Left)
27. Glideslope Antenna

Figure 2-1. General Exterior Arrangement – Left Side (Sheet 2 of 6)



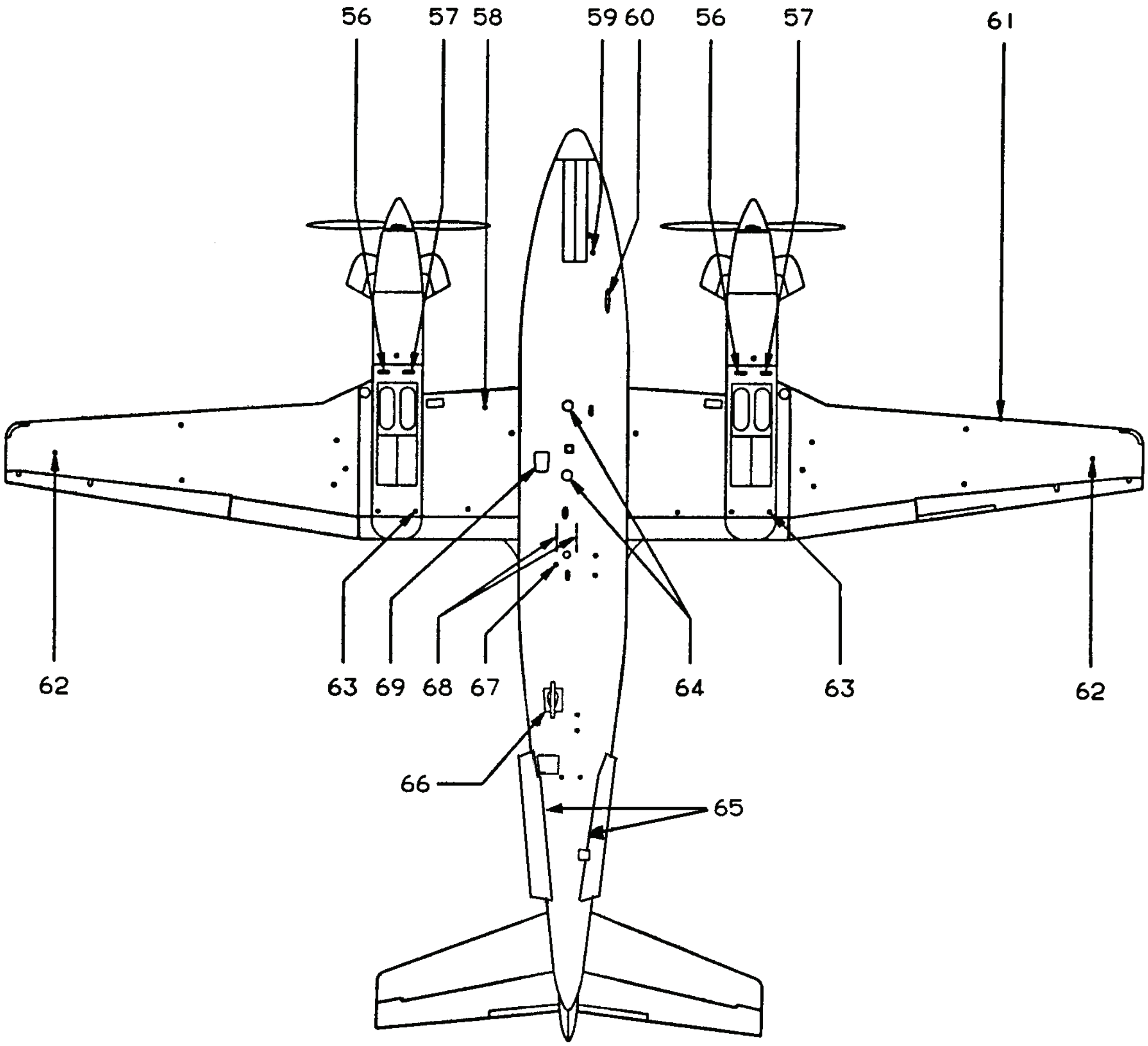
28. Recognition Light
29. Fuel Filler Cap
30. Ice Light
31. Exhaust Stock
32. Emergency Exit Hatch
33. Emergency Locator Transmitter Antenna
34. Elevator Trim Tab
35. Entrance Door
36. Cargo Door
37. Aileron Trim Tab

Figure 2-1. General Exterior Arrangement – Top (Sheet 3 of 6)



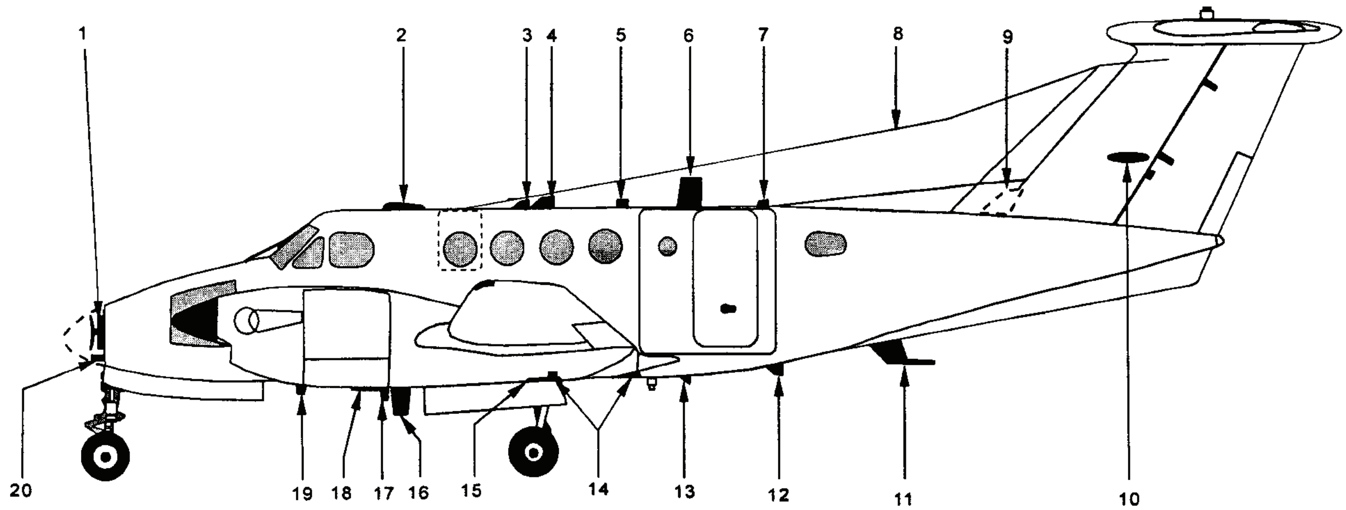
38. Tiedown Ring
39. Leading Edge Fuel Tank Drain
40. DC External Power Receptacle
41. Firewall Fuel Filter Drain
42. Bleed Air Heat Exchanger Air Outlet
43. Battery Ram Air Vent
44. Extended Range Fuel System Drain
45. Hydraulic Reservoir Drain
46. Outboard Wing Fuel Sump Drain
47. Ram Heated Fuel Vent
48. Recessed Fuel Vent
49. Engine Oil Vent
50. Wing Jack Pad
51. Antenna Deice System Boot Hold-down Ejector Tubes
52. Oxygen Regulator Vent
53. Aft Compartment Drain
54. Lightning Sensor System Antenna
55. Tailcone Access Door

Figure 2-1. General Exterior Arrangement – Bottom (Sheet 4 of 6)



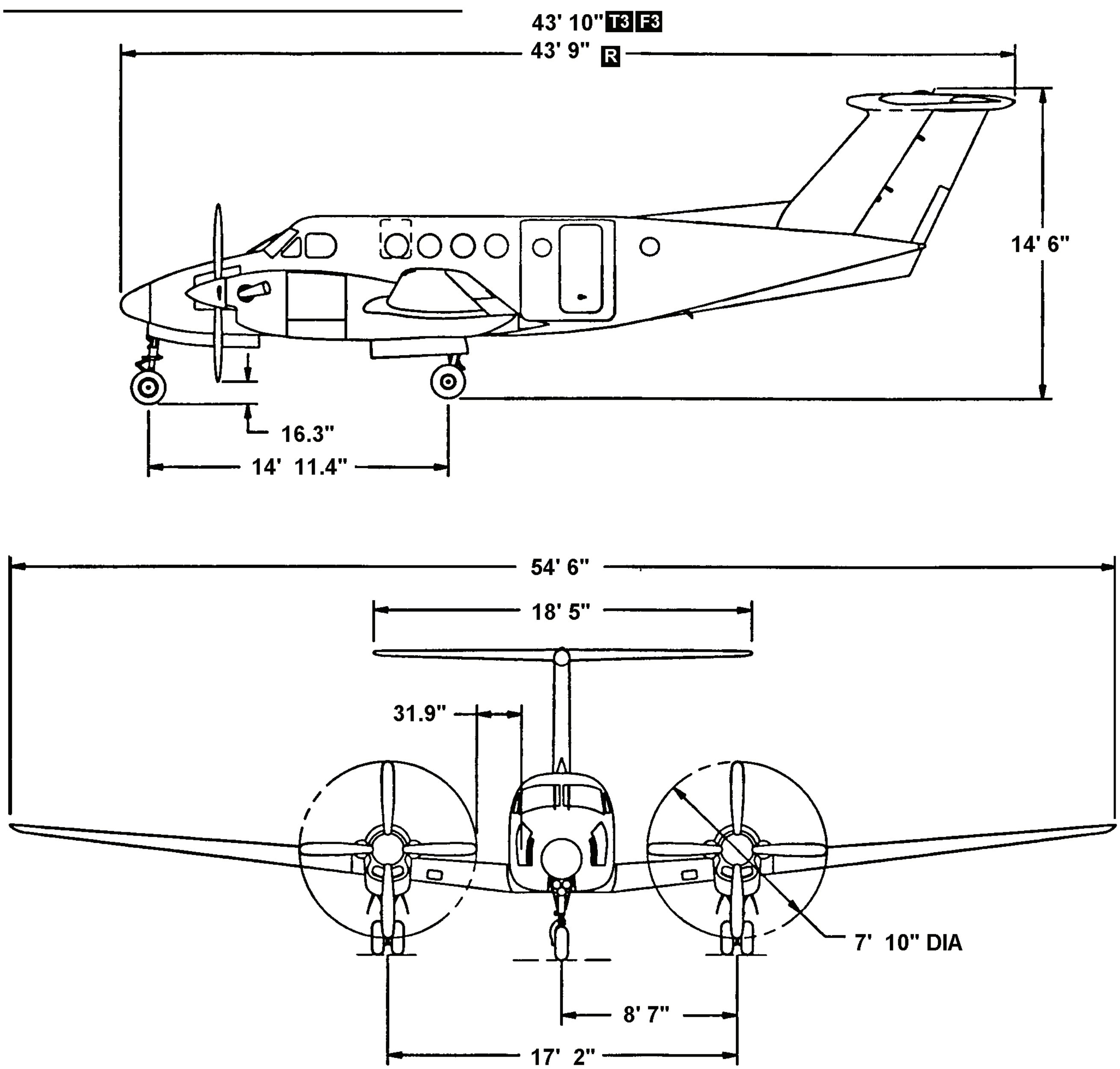
56. Standby Fuel Pump Drain
57. Strainer Drain
58. Battery Drain
59. Nose Jack Pad
60. Marker Beacon Antenna
61. Stall Warning Vane
62. Outboard Wing Fuel Vent
63. Gravity Fuel Line Drain
64. Radio Altimeter Antennas
65. Dual Aft Body Strakes
66. AM/FM (VHF/UHF) Communications Antenna
67. Surface Deice System Ejector Exhaust
68. Strobe Beacon Light Shields
69. ADF Antenna

Figure 2-1. General Exterior Arrangement – Bottom (Sheet 5 of 6)



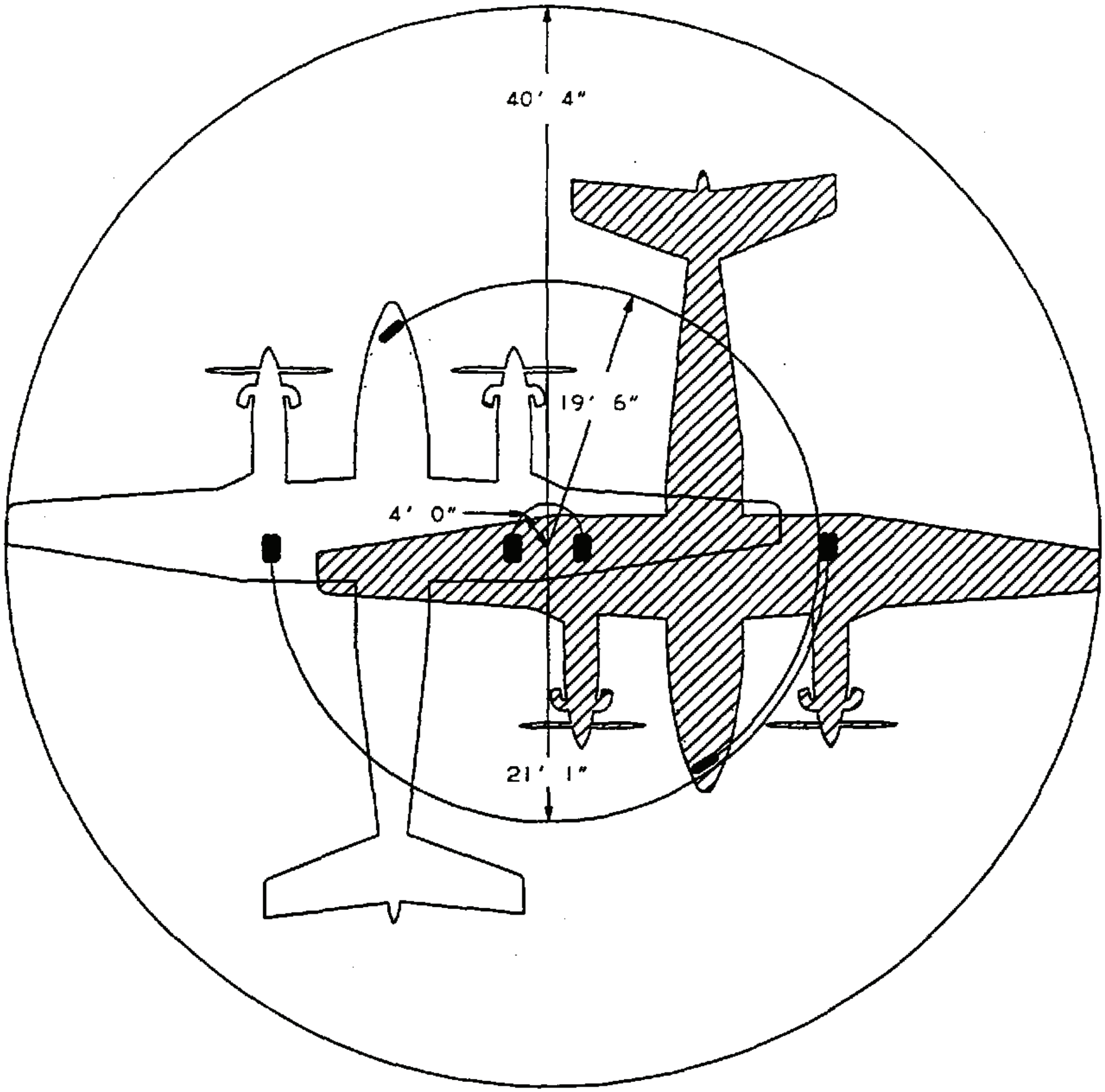
1. Radar Antenna
2. Top TCAS Antenna
3. FMS-800 GPS Antenna
4. GPS Antenna (KLN 90B)
5. Upper Transponder Antenna
6. No. 1 Comm Antenna
7. Top-Mode-S Transponder Antenna
8. HF Comm Antenna Wire OSA
9. ELT Antenna
10. NAV No. 1 and No. 2 Antennas (2)
11. ARC-210 Antenna
12. DME Antenna
13. Lower Transponder Antenna
14. Radio Altimeter Antennas
15. ADF Loop / Sense Antennas
16. No. 2 Comm Antenna
17. Bottom Mode-S Transponder Antenna
18. Marker Beacon Antenna
19. Bottom TCAS Antenna
20. Glideslope Antenna

Figure 2-1. General Exterior Arrangement T3 (Sheet 6 of 6)



F3/T3 aircraft with standard gear: Tail height is 15' 0.5", and prop clearance is 17.0"

Figure 2-2. Principal Dimensions



RADIUS FOR INSIDE GEAR .... 4 FEET

RADIUS FOR NOSE WHEEL ....19 FEET 6 INCHES

RADIUS FOR OUTSIDE GEAR ....21 FEET 1 INCH

RADIUS FOR WING TIP ....40 FEET 4 INCHES R
39 FEET 10 INCHES T3 F3

TURNING RADII ARE PREDICATED ON THE USE OF DIFFERENTIAL BRAKING ACTION AND DIFFERENTIAL POWER. ACTUAL TURNING RADII DEPEND ON SURFACE CONDITIONS AND PILOT TECHNIQUE.

Figure 2-3. Ground Turning Radius

2-6. EXHAUST AND PROPELLER DANGER AREAS.

Exhaust and propeller danger areas to be avoided by personnel while aircraft engines are being operated on the ground are depicted in Figure 2-4. Distance to be maintained with engines operating at idle are also shown. Temperature and velocity of exhaust gases at varying locations aft of the exhaust stacks are shown for maximum power. The danger area extends to 40 feet aft of the exhaust stack outlets. Distances to be maintained with engines operating at idle and propeller danger areas are also shown.

2-7. LANDING GEAR SYSTEM.

The retractable tricycle landing gear is electrically controlled and hydraulically actuated. The landing gear is extended and retracted by a hydraulic power pack, located in the left wing center section, forward of the main spar. The power pack consists primarily of a hydraulic pump, a 28 Vdc motor, a gear selector valve and solenoid, a two section fluid reservoir, filter screens, a gear-up pressure switch, and a low fluid level sensor. Engine bleed air, regulated to 18 to 20 psi, is plumbed into the power pack reservoir and the system fill reservoir to prevent cavitation of the pump. The fluid level sensor activates a yellow caution annunciator, placarded **HYD FLUID LOW**, located on the caution / advisory annunciator panel, whenever the fluid level in the power pack is low. Test the annunciator by pressing the **HYD FLUID SENSOR TEST** switch located on the pilot's subpanel for the aircraft. Refer to Figure 2-5, Sheets 1 through 8.

Power for the hydraulic power pack is supplied through the landing gear motor relay and a 60-ampere circuit breaker located under the floorboard forward of the main spar. The motor relay is energized by power furnished through the 2-ampere **LANDING GEAR RELAY** circuit breaker located on the pilot's subpanel. A time delay module that senses operation voltage through a 5-ampere circuit breaker protects the power pack motor. Both are located beneath the aisleway floorboards, forward of the main spar. Landing gear extension or retraction is normally accomplished in 6 to 7 seconds. Voltage to the power pack is terminated after the fully extended or retracted position is reached. If electrical power has not terminated within 14 seconds, a relay and 2-ampere landing gear circuit breaker will open and electrical power to the system power pack will be interrupted.

The landing gear system utilizes folding braces, called drag legs, which lock into place when the gear is fully extended. The nose landing gear actuator incorporates an internal down lock to hold the gear in the fully extended position. The two main landing gears are held in the fully extended position by mechanical hook and pin locks. The landing gear is held in the up position by hydraulic pressure. The power pack pressure switch and an accumulator that is pre-charged with nitrogen to 800 ± 50 psi control the pressure. Gear doors are opened and closed through a mechanical linkage connected to the landing gear. The nose wheel steering mechanism is automatically centered and the rudder pedals relieved of the steering load when the landing gears are retracted. Air-oil type shock struts, filled with compressed nitrogen and hydraulic fluid, are incorporated with the landing gear.

a. Landing Gear Control Switch*.* Landing gear system operation is controlled by a manually actuated, wheel-shaped switch, placarded **LDG GEAR CONTROL UP / DN**, located on the pilot's subpanel. The control switch and associated relay circuits are protected by a 2-ampere circuit breaker, placarded **LANDING GEAR RELAY**, located on the pilot's subpanel.

b. Landing Gear Down Position Indicator Lights. Visual indication of landing gear position is provided by three individual green **GEAR DOWN** position indicator lights located on the pilot's subpanel. Testing of the indicator lights is accomplished by pressing the annunciator test switch. The circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR IND**, on the right sidewall circuit breaker panel. Refer to Figure 2-6, Sheets 1 through 5, for the circuit breaker panels for the C-12R, C-12T3, and C-12F3 (OSA) (ANG) aircraft.

c. Landing Gear Position Warning Lights*.* Two parallel-wired red indicator lights, located in the **LDG GEAR CONTROL** switch handle, illuminate to show that the gear is in transit or unlocked. The red indicator lights in the handle also illuminate when the landing gear warning horn is actuated. Both red indicator lights indicate the same warning conditions, but two are provided for a fail-safe indication in case one bulb bums out. The circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR IND**, on the right sidewall circuit breaker panel.

d. Landing Gear Warning Indicator Light Test Switch. A test switch, placarded **HDL LT TEST**, is located on the pilot's subpanel. When this test switch is pressed, failure of the landing gear handle to illuminate red indicates two defective bulbs or a circuit fault. The circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR WARN**, on the right sidewall circuit breaker panel.

NOTE

The danger areas include the resultant increase in velocity and significant reduction in temperature due to propeller wake.

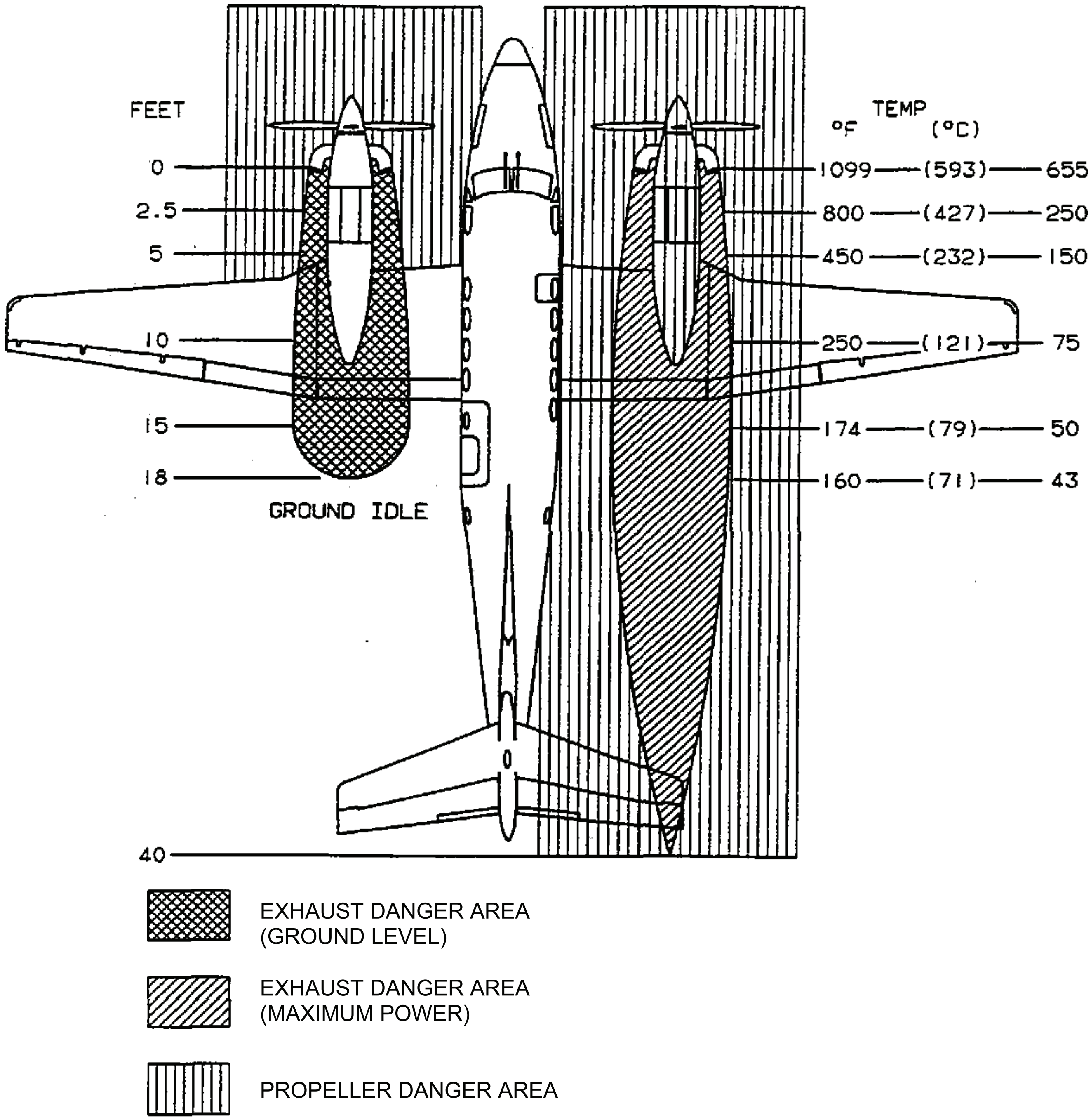
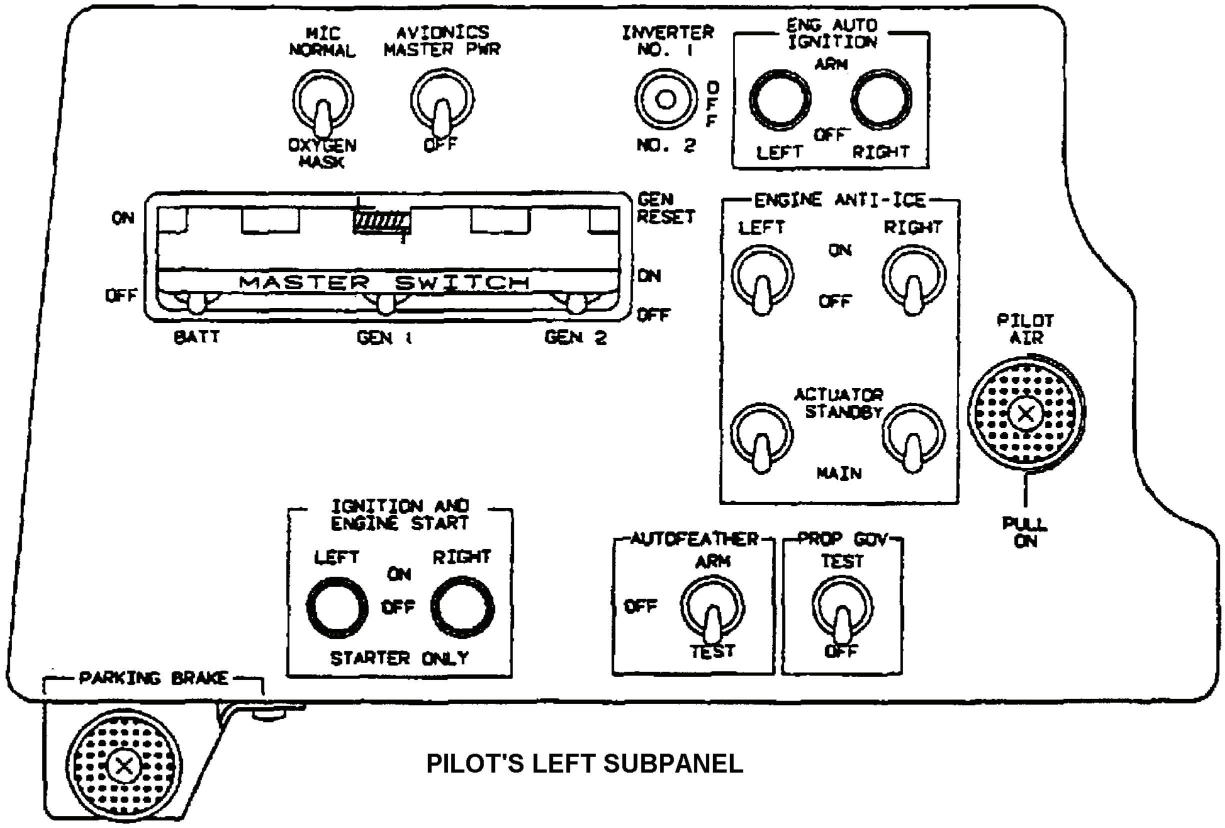
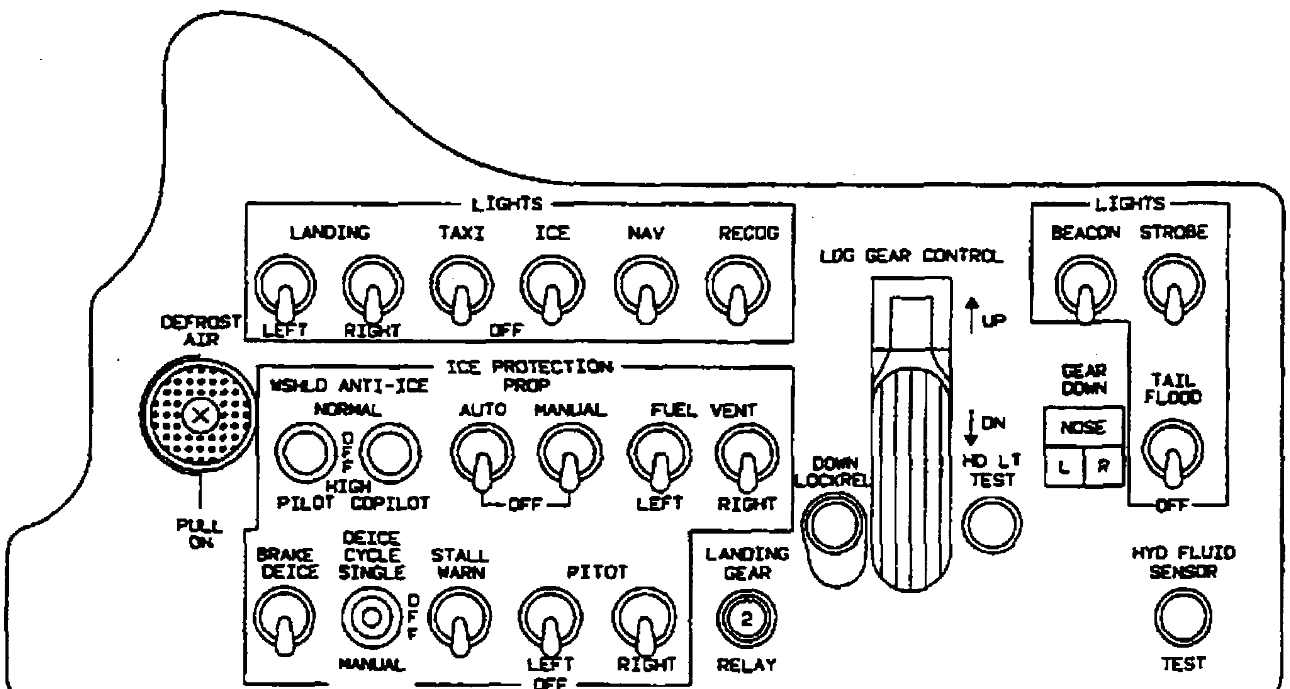


Figure 2-4. Exhaust and Propeller Danger Areas

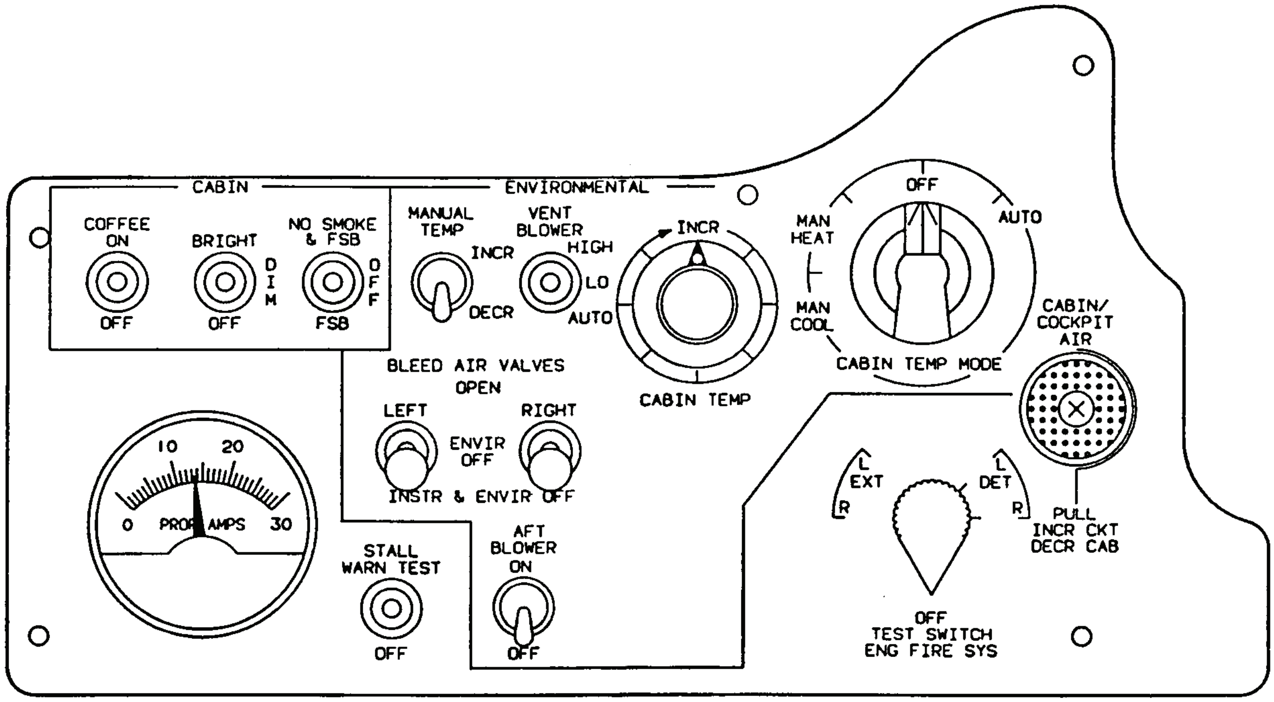


PILOT'S LEFT SUBPANEL

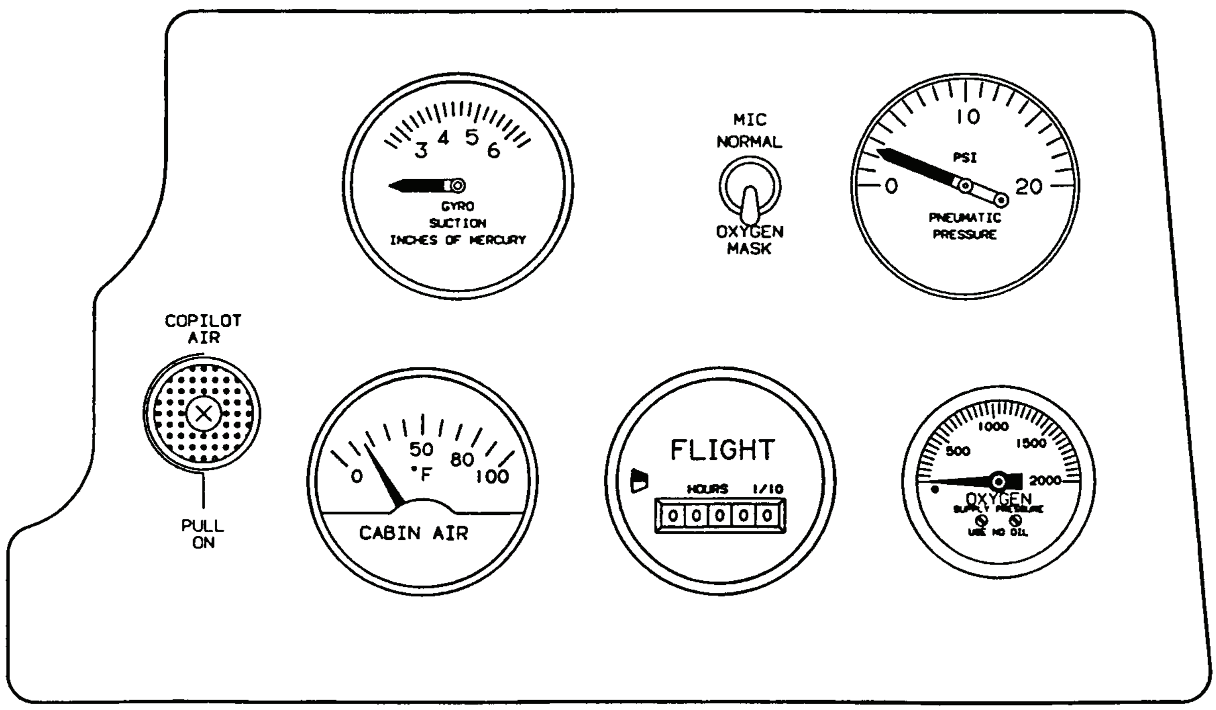


PILOT'S RIGHT SUBPANEL

Figure 2-5. Subpanels **R** *(Sheet 1 of 8)*

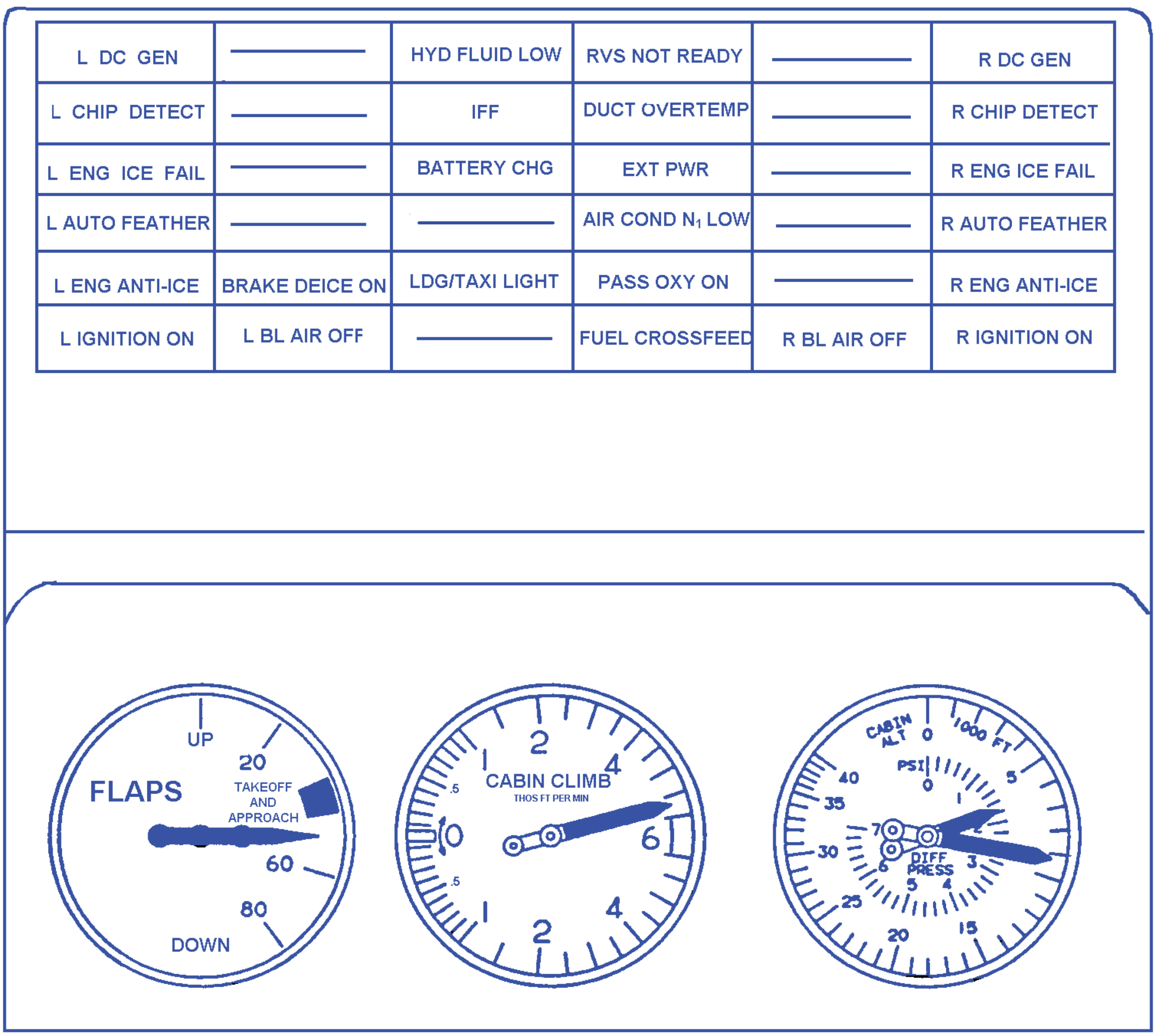


COPILOT'S LEFT SUBPANEL



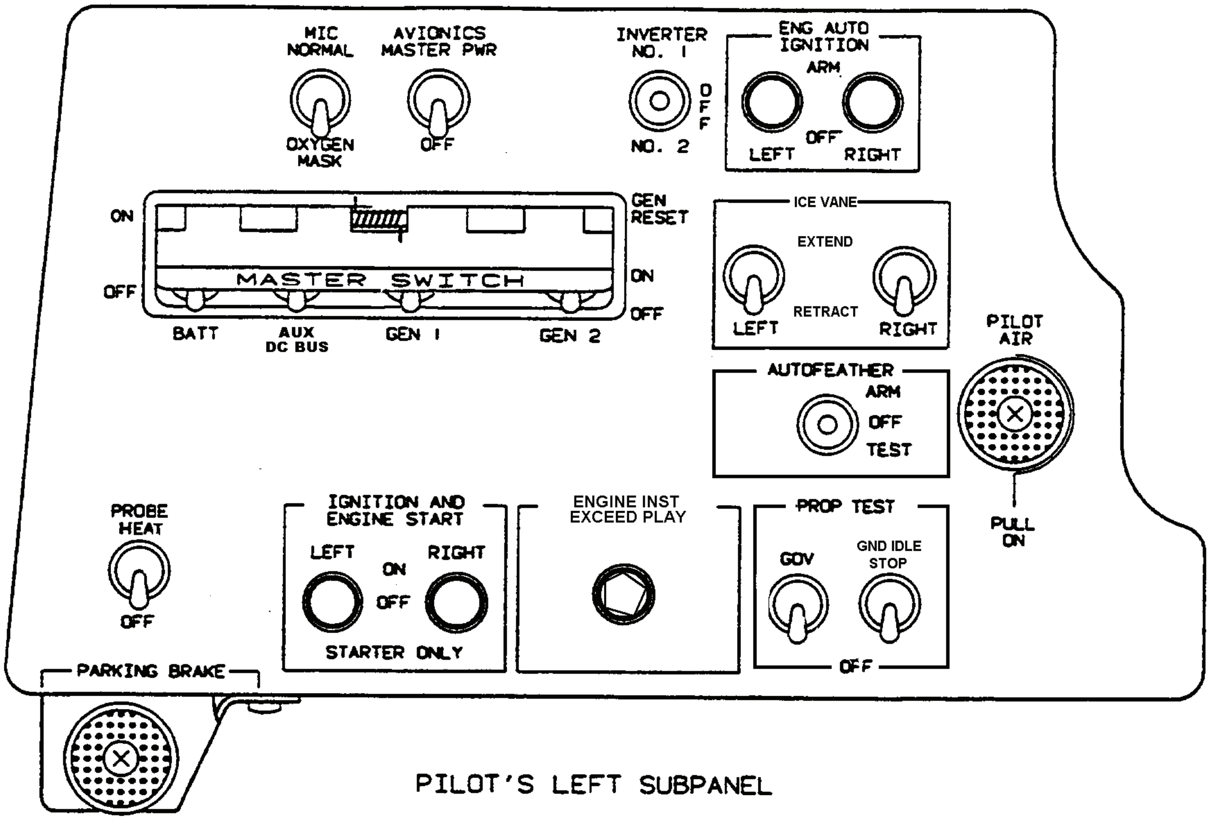
COPILOT'S RIGHT SUBPANEL

Figure 2-5. Subpanels **R** *(Sheet 2 of 8)*

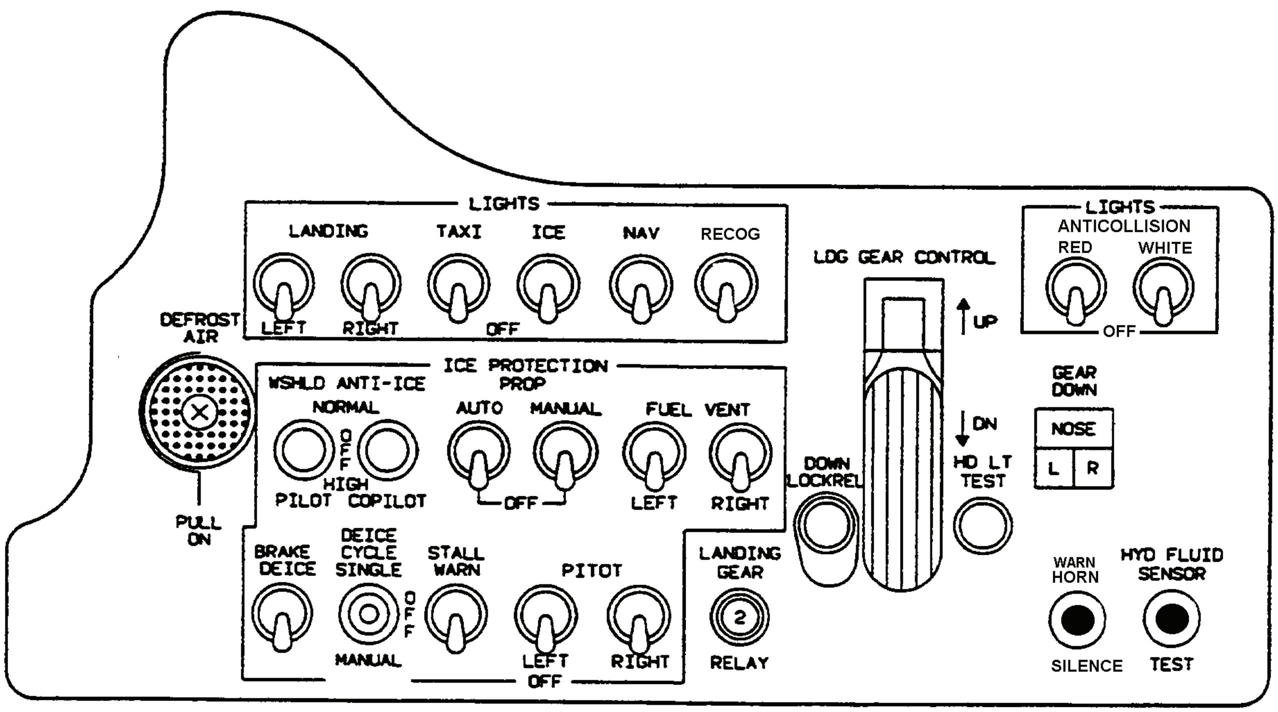


CENTER SUBPANEL

Figure 2-5. Subpanels **R** *(Sheet 3 of 8)*

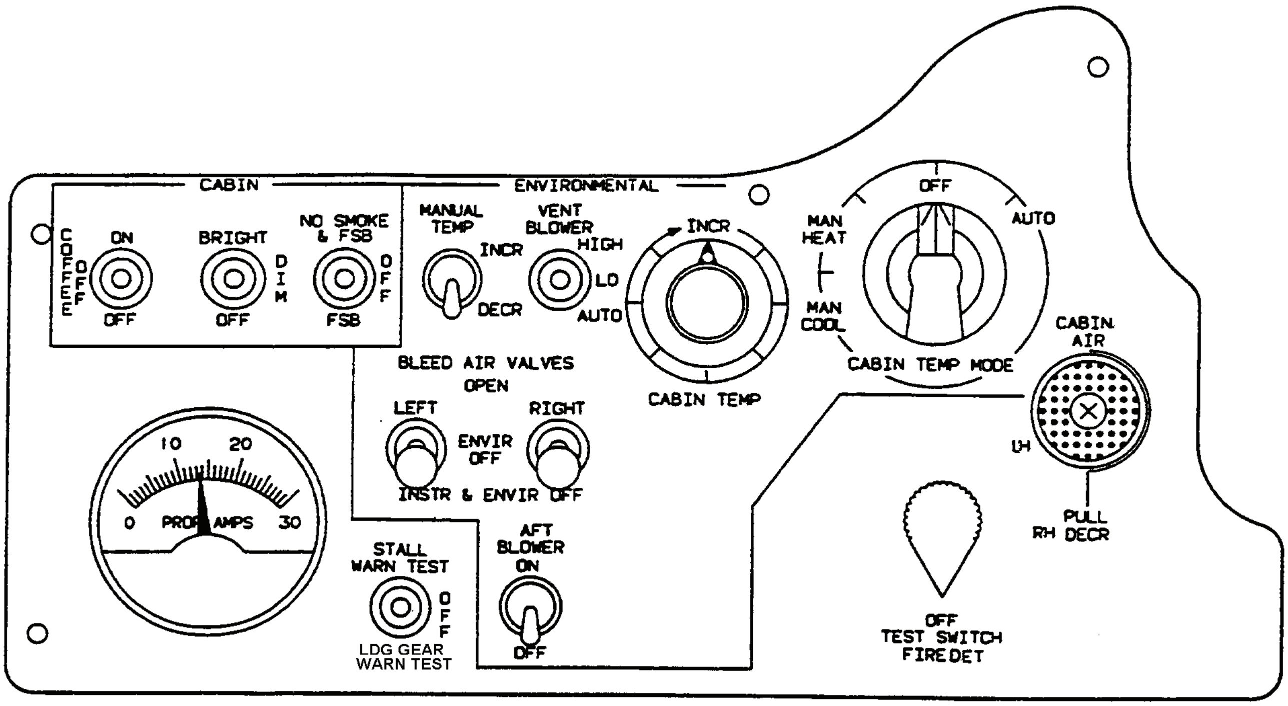


PILOT'S LEFT SUBPANEL

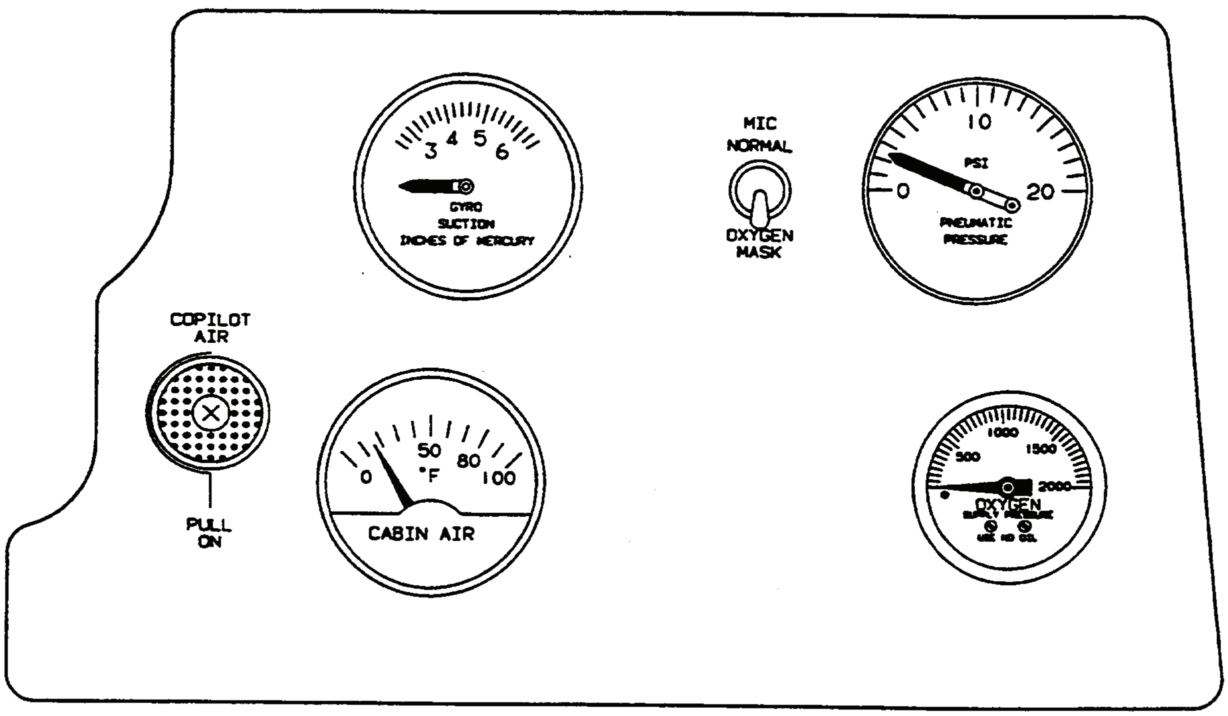


PILOT'S RIGHT SUBPANEL

Figure 2-5. Subpanels T3 (Sheet 4 of 8)

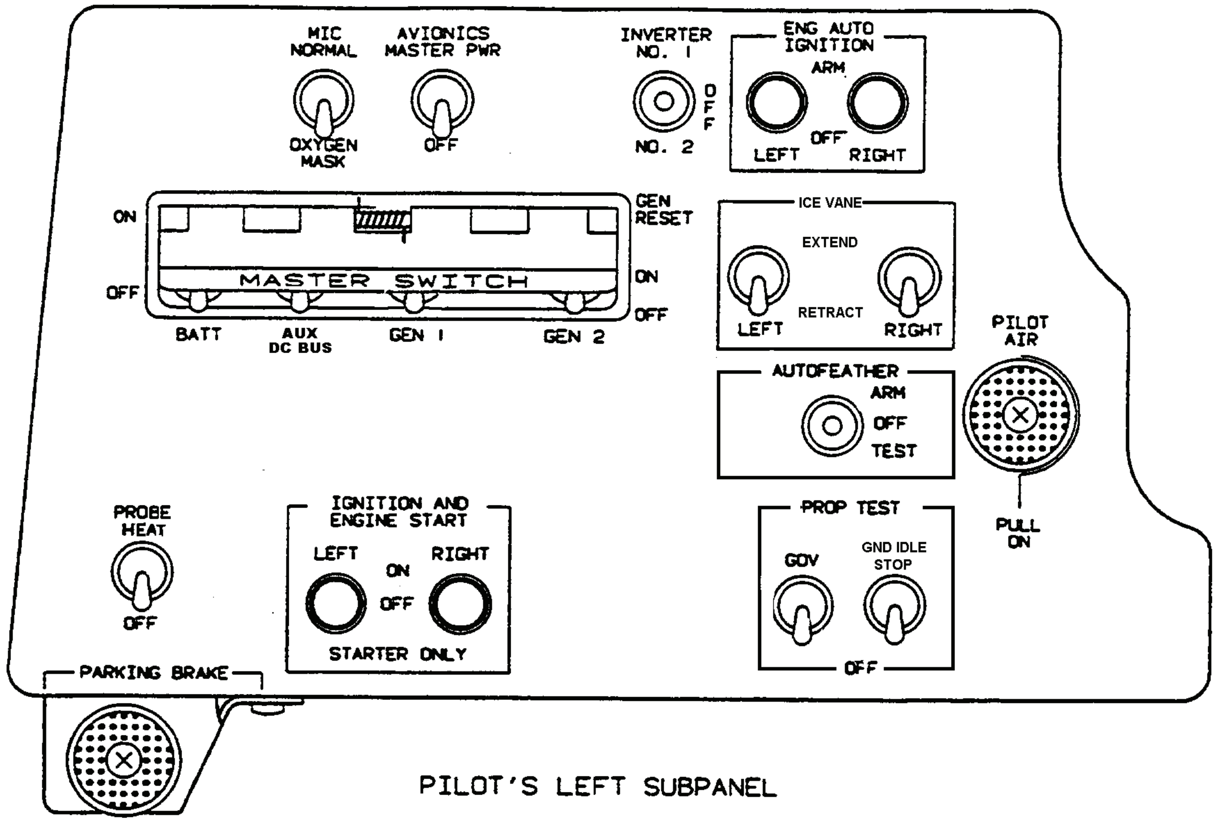


COPILOT'S LEFT SUBPANEL

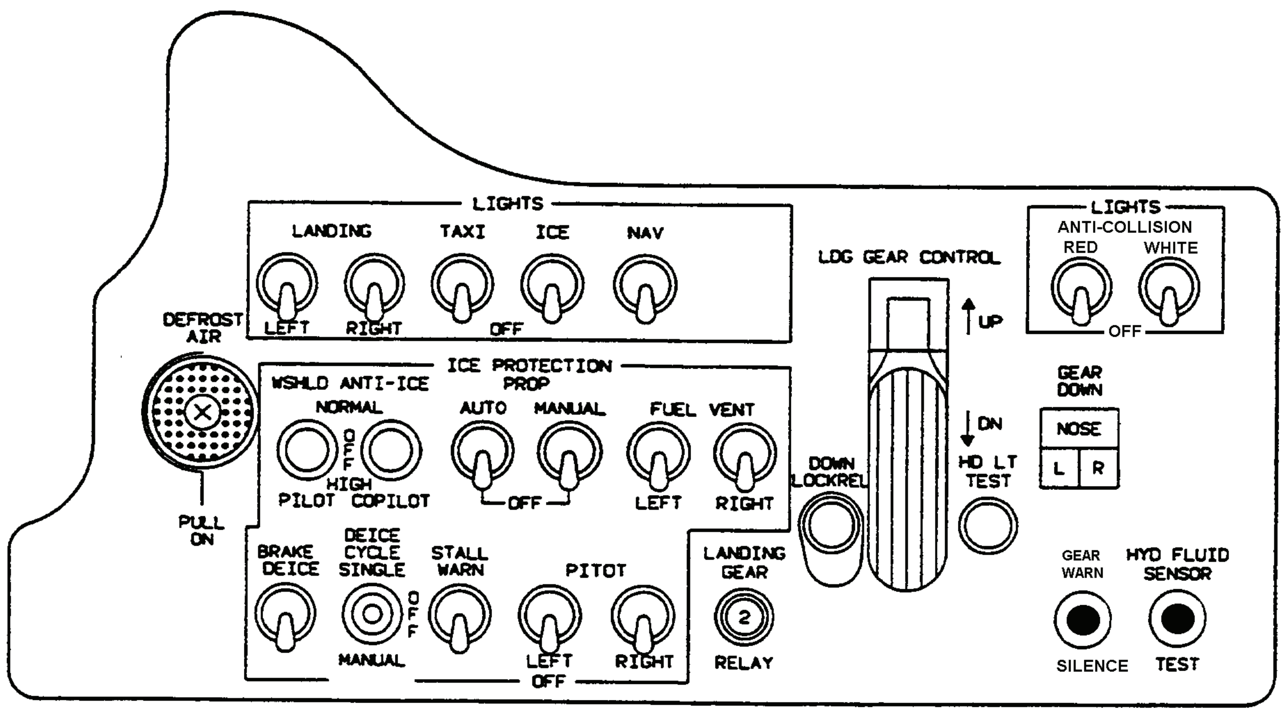


COPILOT'S RIGHT SUBPANEL

Figure 2-5. Subpanels **T3** *(Sheet 5 of 8)*

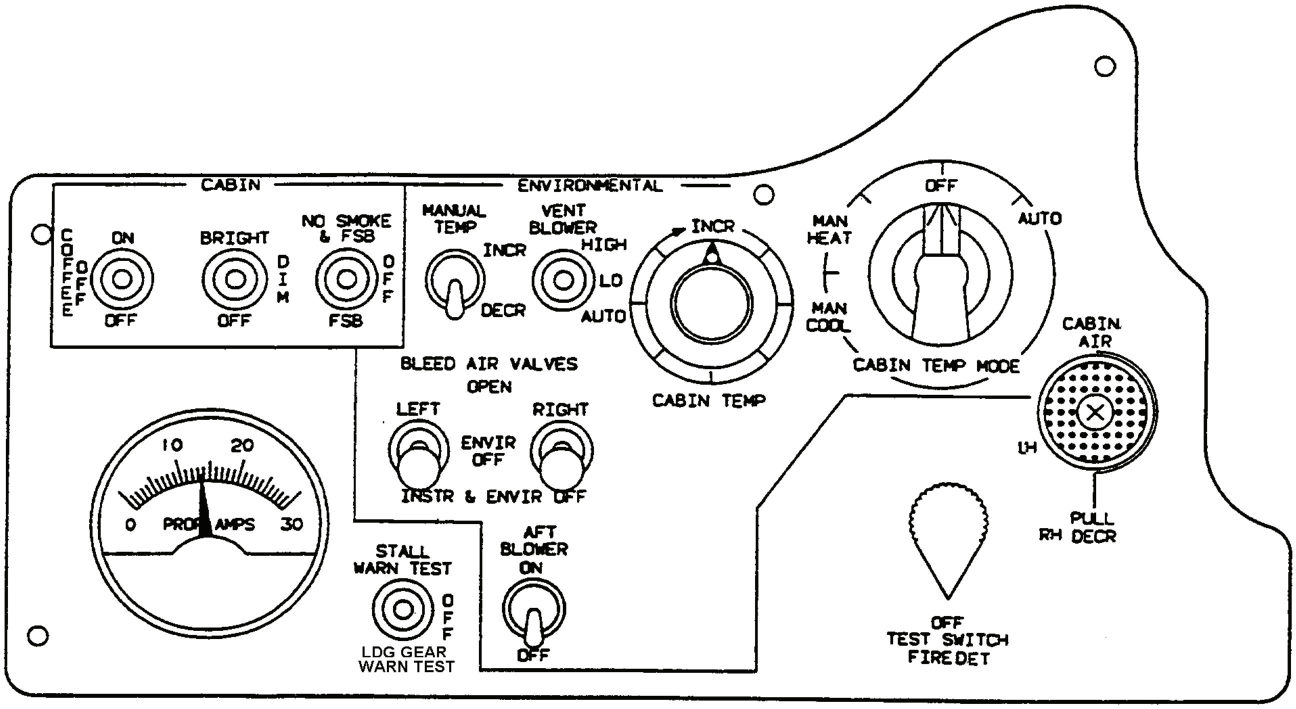


PILOT'S LEFT SUBPANEL

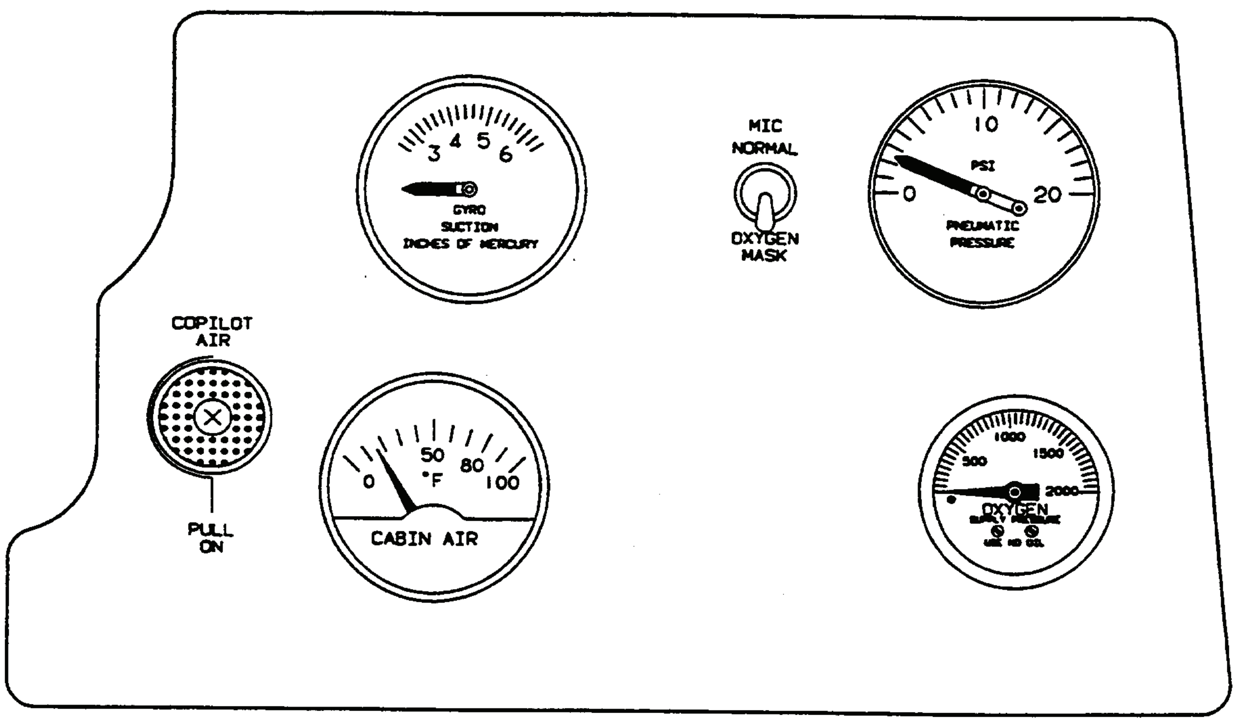


PILOT'S RIGHT SUBPANEL

Figure 2-5. Subpanels F3 (Sheet 6 of 8)

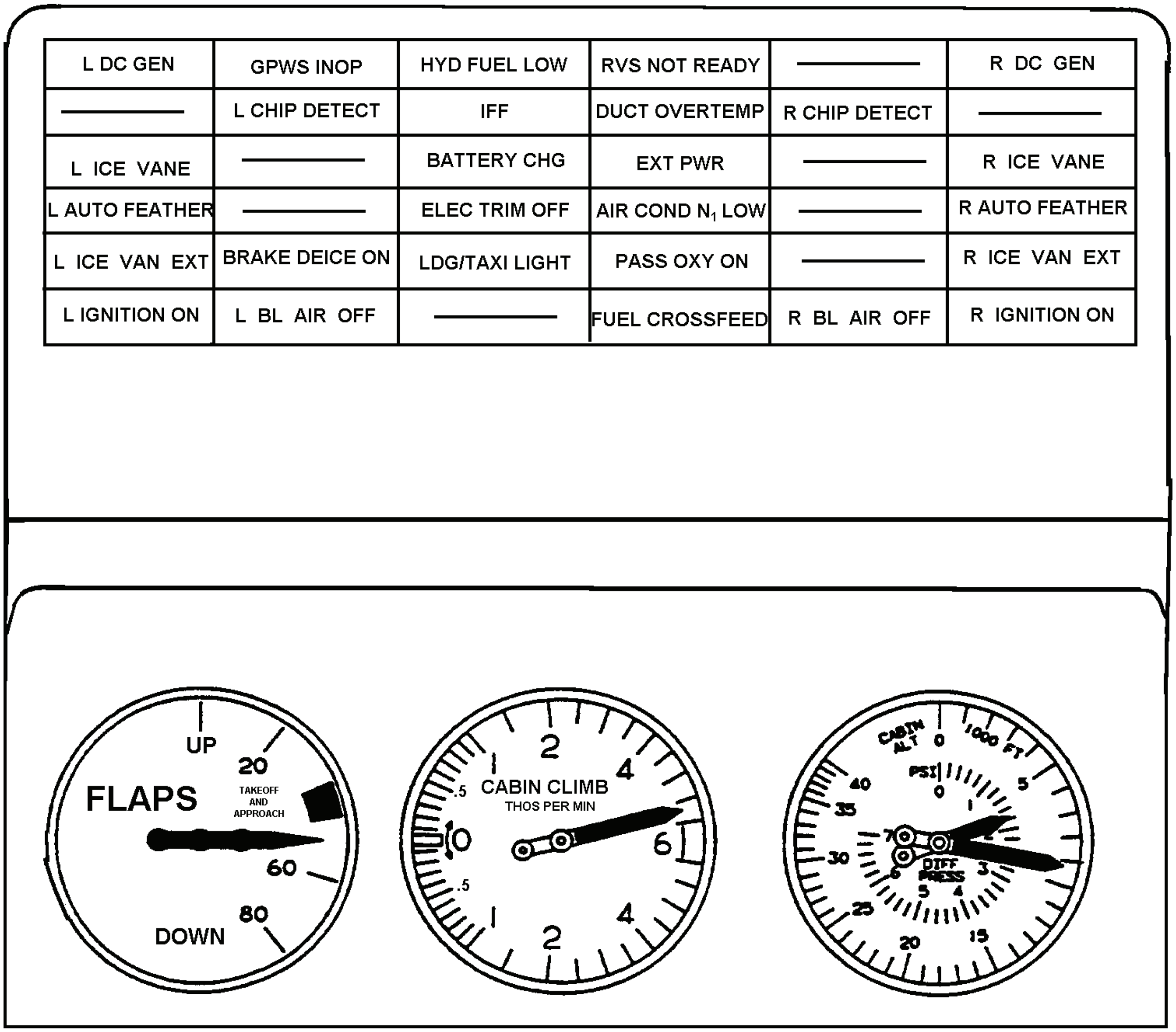


COPILOT'S LEFT SUBPANEL



COPILOT'S RIGHT SUBPANEL

Figure 2-5. Subpanels **F3** *(Sheet 7 of 8)*



CENTER SUBPANEL

Figure 2-5. Subpanels T3 F3 (Sheet 8 of 8)

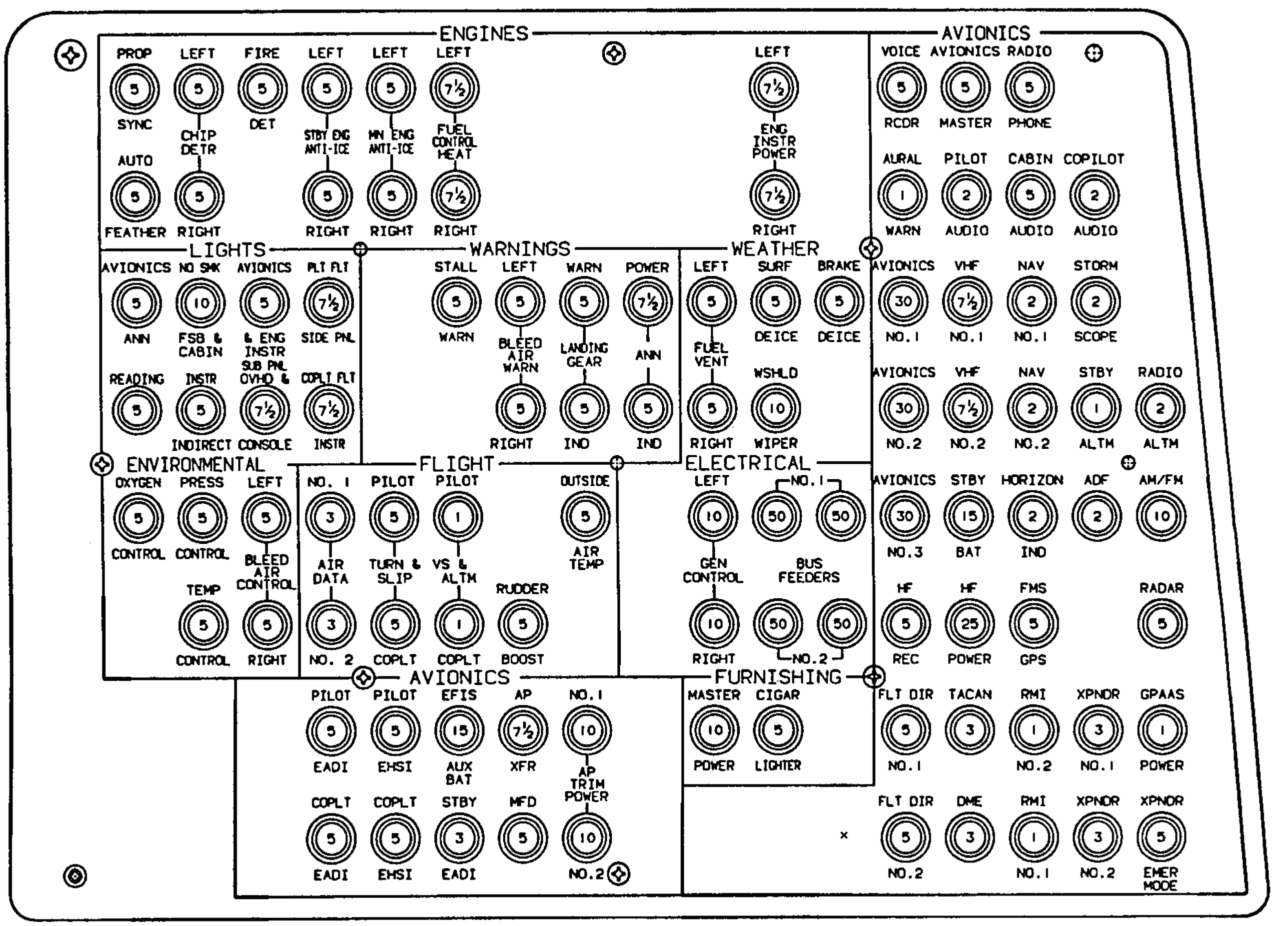


*Figure 2-6. Circuit Breaker Panel **R** (Sheet 1 of 5)*

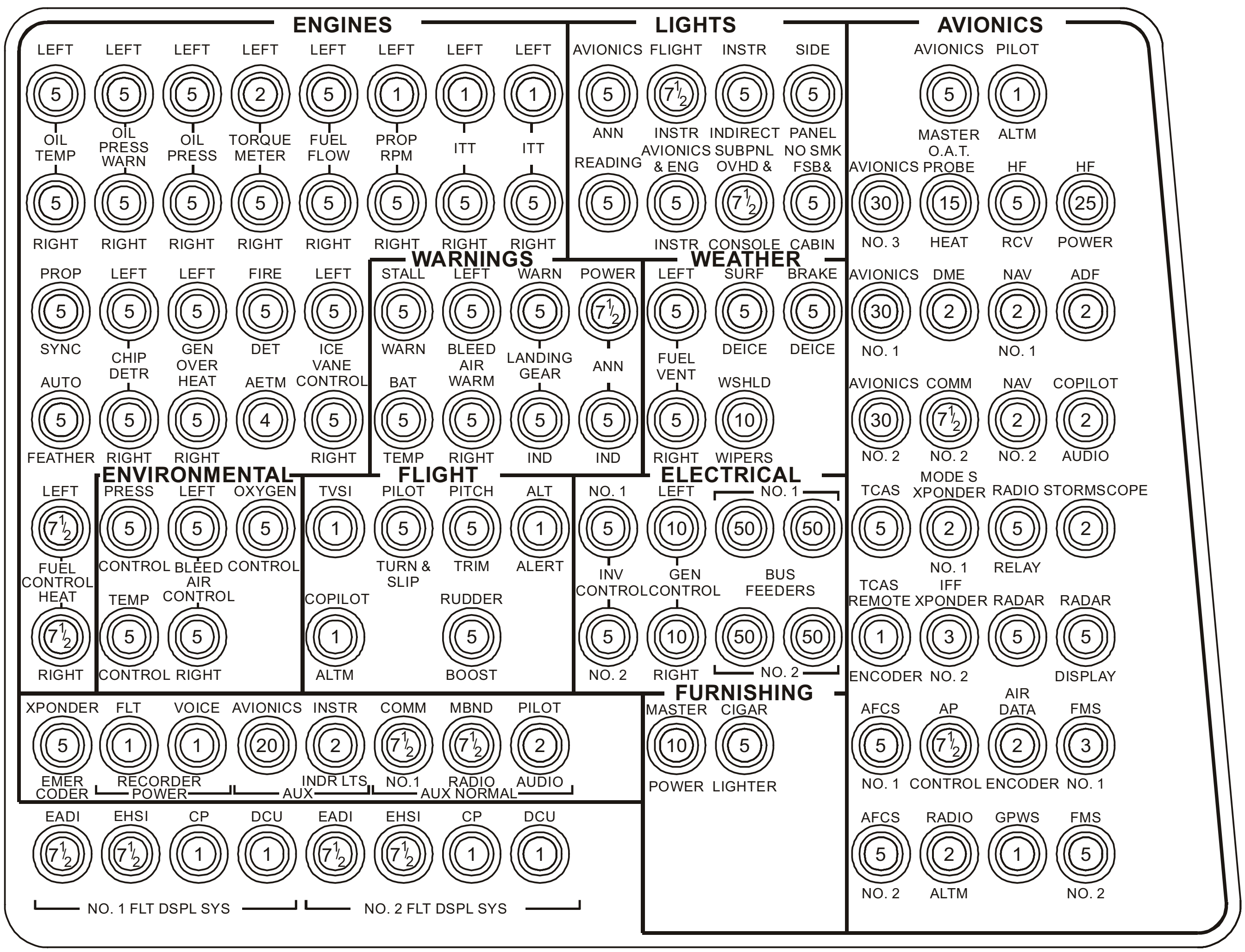


Figure 2-6. Circuit Breaker Panel T3 OSA (Sheet 2 of 5)

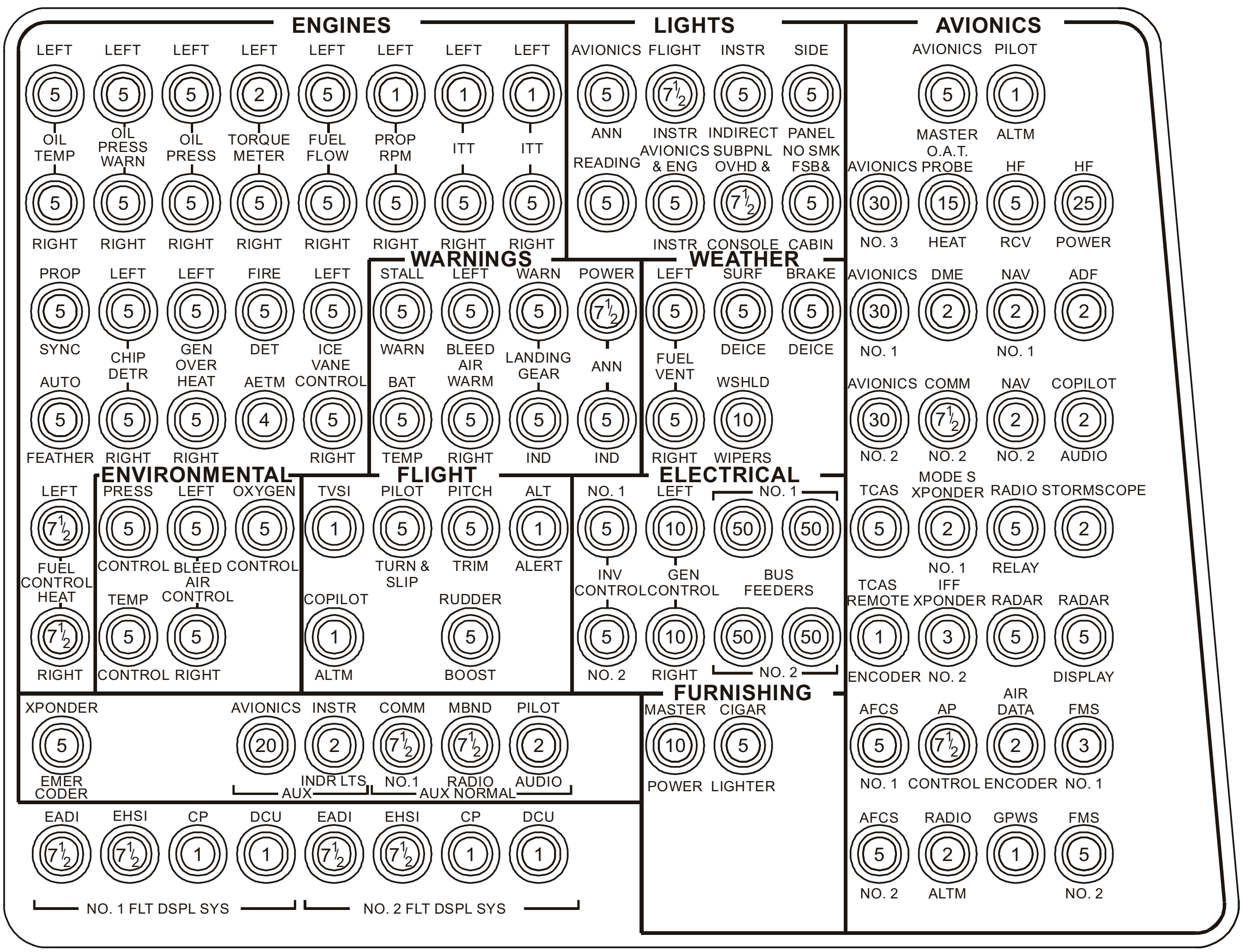


Figure 2-6. Circuit Breaker Panel **T3** **ANG** *(Sheet 3 of 5)*

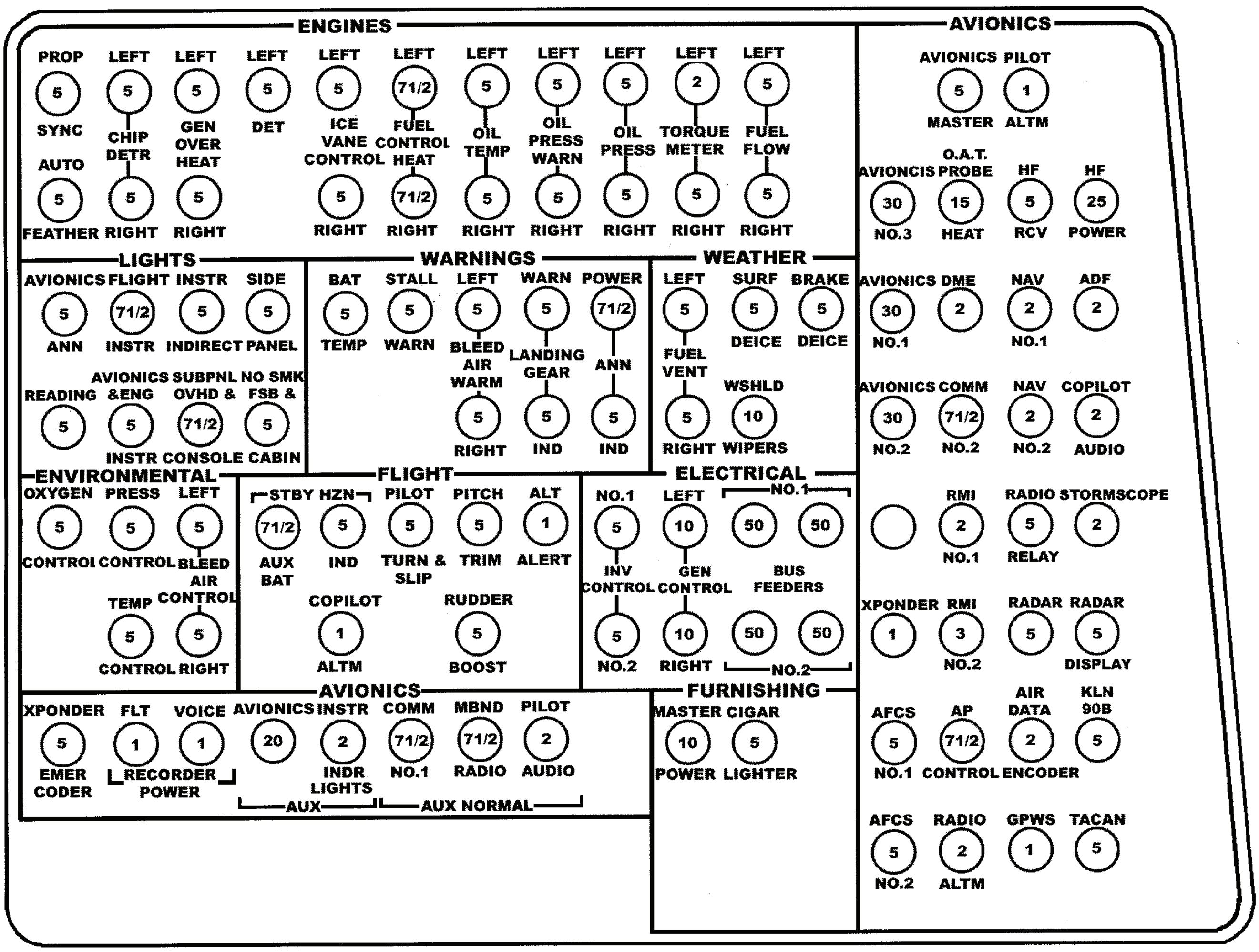


Figure 2-6. Circuit Breaker Panel **F3** **OSA** *(Sheet 4 of 5)*

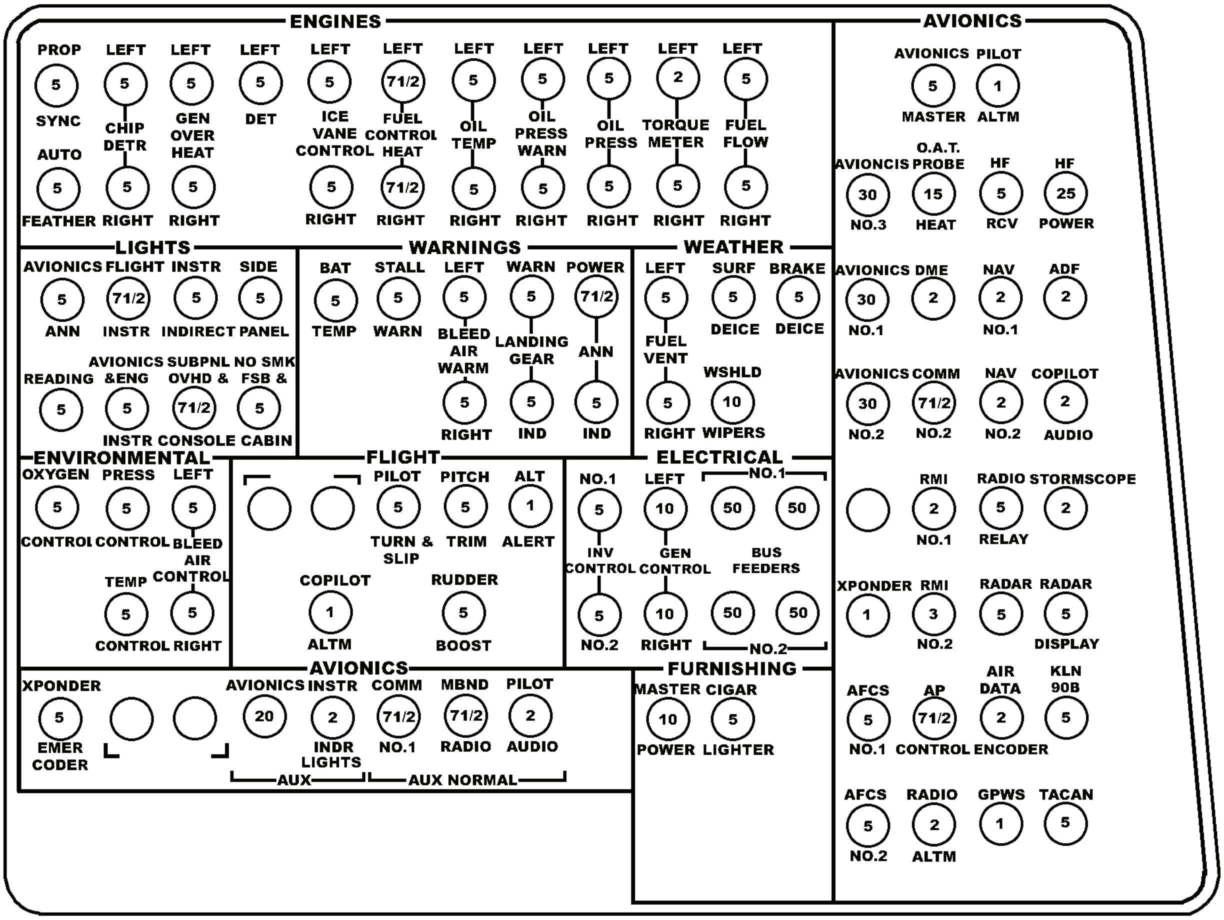


Figure 2-6. Circuit Breaker Panel F3 ANG (Sheet 5 of 5)

e. Landing Gear Warning System. The landing gear warning system is provided to warn the pilot that the landing gear is not down and locked during specific flight regimes. Various warning modes result, depending upon the position of the flaps.

With flaps in the **UP** or **APPROACH** positions and either or both **POWER** levers retarded below approximately 80% N_1, the warning horn will sound and the landing gear switch handle indicator lights will illuminate. Silence the horn by pressing the **GEAR HORN SILENCE** switch, located on the left **POWER** lever, or the **GEAR WARN SILENCE** button adjacent to the landing gear handle switch (F3/T3). However, the lights in the landing gear switch handle cannot be canceled. The gear warning silence switch is a magnetically held switch. Once actuated it will stay in the **UP** position until both **POWER** levers are advanced above 86% N_1. The landing gear warning system will be rearmed if both **POWER** levers are advanced above 86% N_1.

With the landing gear retracted and flaps beyond the **APPROACH** position, the warning horn and landing gear switch handle lights will be activated regardless of the power setting. The horn cannot be silenced in this case, until either the landing gear is lowered or the flaps are retracted to the **UP** or **APPROACH** position.

f. Landing Gear Safety Switches. A safety switch on each main landing gear shock strut controls the operation of various aircraft systems that function only during flight or only during ground operation. These switches are mechanically actuated whenever the main landing gear shock struts are extended (normally after takeoff) or compressed (normally after landing). The safety switch on the right main landing gear strut deactivates the landing gear control circuits, cabin pressurization circuits, and the flight hour meter when the shock strut is compressed. This switch also activates a downlock hook, preventing the landing gear from being raised while the aircraft is on the ground. The hook, which unlocks automatically after takeoff, can be manually overridden by pressing down on the red button, placarded **DN LOCK REL**, located adjacent to the landing gear handle on the pilot's subpanel. If the override is used, the landing gear warning horn will sound intermittently and two parallel-wired red indicator lights, located in the landing gear control switch handle, will illuminate, provided the battery switch is on. The safety switch on the left main landing gear strut activates the left and right engine ambient air shut-off valves when the strut is extended.

g. Landing Gear Alternate Extension. An extension lever, placarded **LANDING GEAR ALTERNATE EXTENSION**, is located on the floor between the crew seats. Manually pumping the lever lowers the landing gear. The hydraulic pump, which is utilized to manually lower the gear, is located under the floor.

WARNING

After an emergency landing gear extension has been made, do not move any landing gear controls or reset any switches or circuit breakers until the aircraft is on jacks. The failure may have been in the gear-up circuit, which could cause the gear to retract while the aircraft is on the ground.

If for any reason the three green GEAR DOWN indicator lights do not illuminate (e.g., in case of an electrical system failure), continue pumping until sufficient resistance is felt to ensure that the gear is down and locked. Do not stow the hand pump handle. Stowing the handle will release hydraulic pressure. If the three GEAR DOWN indicator lights are not illuminated, the landing gear downlocks may not be engaged and hydraulic pressure may be the only thing holding the landing gear down.

To engage the system, pull the **LANDING GEAR RELAY** circuit breaker, located on the pilot's subpanel, and ensure that the **LDG GEAR CONTROL** handle is in the **DN** position. Remove the extension lever from the securing clip and pump the lever up and down until the three green **GEAR DOWN** indicator lights illuminate. As the handle is moved, hydraulic fluid is drawn from the hand pump suction port of the power pack and routed through the hand pump pressure port to the actuators. After an alternate extension of the landing gear, ensure that the extension lever is in the full down position prior to stowing the lever in the retaining clip. When the lever is stowed, an internal relief valve is actuated to relieve the hydraulic pressure in the pump.

After a practice alternate extension, stow the extension lever, reset the **LANDING GEAR RELAY** circuit breaker, and retract the gear in the normal manner with the landing gear control handle.

h. Tires. The aircraft is equipped with dual 22 x 6.75 x 10, 8 ply rated, tubeless rim-inflation tires on each main gear or 18 x 5.5, 8 ply rated (standard gear F3/T3) and a 22 x 6.75 x 10, 8 ply rated, tubeless tire on the nose wheel.

i. Nose Wheel Steering System. The aircraft is maneuvered on the ground by the nose wheel steering system. Direct linkage from the rudder pedals to the nose wheel steering linkage allows the nose wheel to be turned 12° to the left of center or 14° to the right. When rudder pedal steering is augmented by main wheel braking action, the nose wheel can be deflected up to 48° either side of center. Shock loads, which would normally be transmitted to the rudder pedals, are absorbed by a spring mechanism in the steering linkage. Retraction of the landing gear automatically centers the nose wheel and disengages the steering linkage from the rudder pedals. Refer to Figure 2-7.

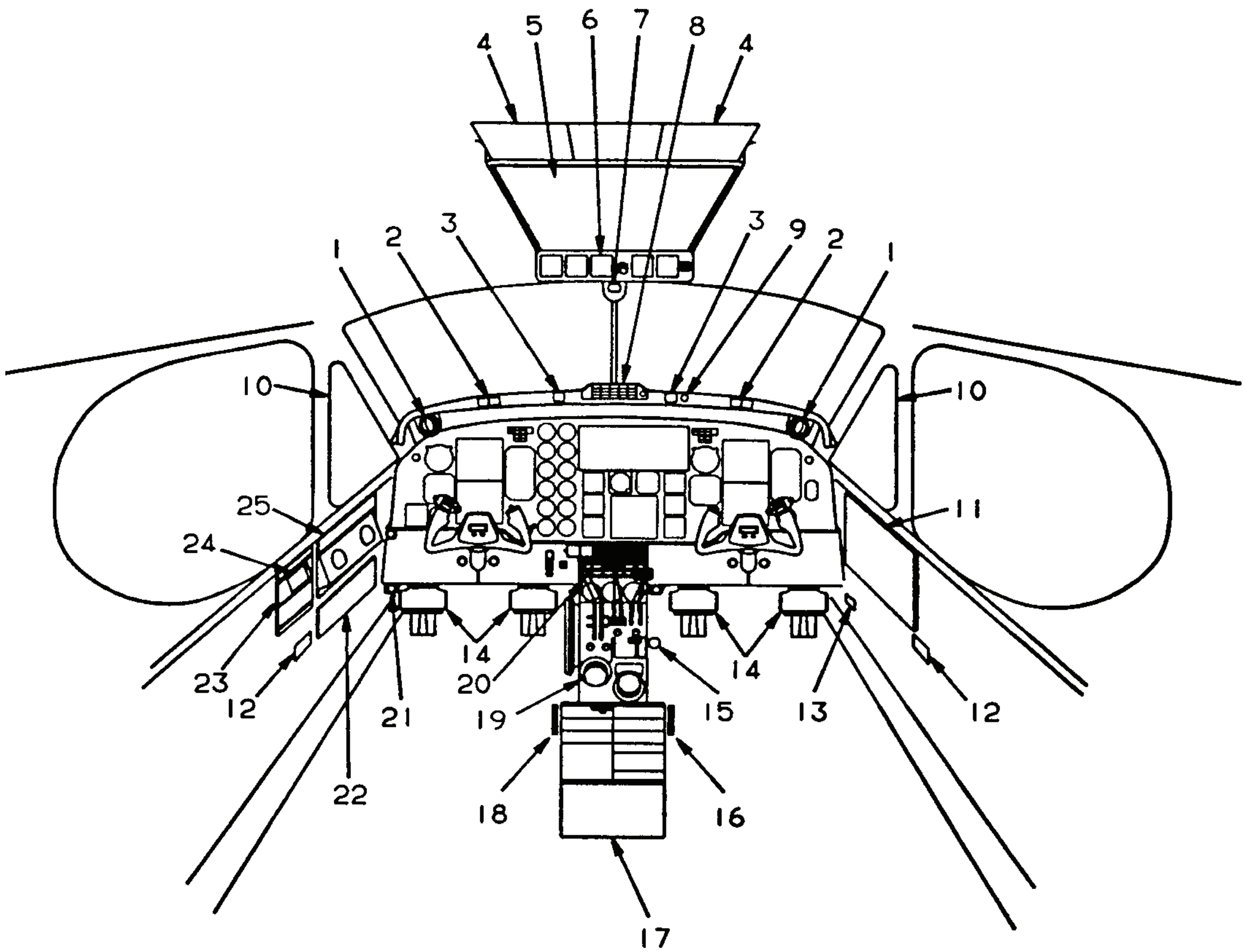
CAUTION

Repeated application of brakes with insufficient cooling time between applications will cause a loss of braking efficiency, and may cause brake failure, wheel failure, tire blowout, or destruction of wheel assembly by fire.

j. Wheel Brake System. The main wheels are equipped with multiple-disc hydraulic brakes actuated by master cylinders attached to the toe brake sections of the rudder pedals. Brake fluid is supplied to the system from a reservoir in the nose compartment. Braking is permitted from either set of rudder pedals. No emergency brake system is provided.

2-8. PARKING BRAKE.

Dual parking brake valves are installed below the cockpit floor. Both valves can be closed simultaneously by pressing both brake pedals in either cockpit position to build up pressure, then pulling out the handle, placarded **PARKING BRAKE**, on the pilot's subpanel. Pulling the handle full out sets the check valves in the system and any pressure being applied by the toe brakes is maintained. The parking brake is released when the brake handle is pushed in. The parking brake may be set from either the pilot's or copilot's position. The parking brake shall not be set during flight.



1. Ventilation Air Outlet
2. Master Warning / Master Caution Switches
3. Engine Fire Detection / Extinguisher Switch Indicators (R models)
4. Crew Oxygen Masks
5. Overhead Control Panel
6. Electrical Equipment Gauges
7. Standby Magnetic Compass
8. Warning Annunciator Panel
9. Cockpit Voice Recorder Microphone
10. Storm Window
11. Right Sidewall Circuit Breaker Panel
12. Headset Jacks
13. Alternate Static Air Source Selector Control
14. Rudder Pedals
15. Foot Operated Microphone Switch
16. Passenger Manual Oxygen Control Handle (located overhead and aft for F3/T3)
17. Control Pedestal Extension
18. Oxygen On / Off Control Handle (located overhead and aft for F3/T3)
19. Control Pedestal
20. Caution / Advisory Annunciator Panel
21. Parking Brake Handle
22. Left Sidewall Circuit Breaker Panel
23. ELT Transmit Indicator Light and Control Switch (R models)
24. Free Air Temperature Indicator
25. Fuel Management Panel

Figure 2-7. Cockpit

2-9. ENTRANCE AND EXIT PROVISIONS.

NOTE

Two keys are provided in the loose tools and equipment bag. Both keys fit the locks on the cabin door, emergency hatch, tailcone access door, and the right and left nose avionics compartment doors.

a. Cabin Door.

CAUTION

Structural damage may occur if more than one person is present on the airstair cabin door at one time. The door is weight limited to 300 pounds.

An airstair cabin door, hinged at the bottom, provides a stairway, for normal and emergency entrance and exit. Refer to Figure 2-8. In the closed position, the door becomes an integral part of the cargo door. The cabin door is provided with steps, two of which fold flat against the door in the closed position. A step folds down over the doorsill when the door opens to provide a platform (step) for door seal protection. T3 F3 A plastic-encased cable provides a handhold and support for the door in the open position and a convenience for closing the door from inside. R Two plastic-encased cables provide a handhold and support for the door in the open position and a convenience for closing the door from inside. A hydraulic damper permits the door to lower gradually during opening. A rubber seal around the door seals the pressure vessel while the aircraft is in flight. The door locking mechanism is by either of the two mechanically interconnected handles, one inside and the other outside the door. When either handle is rotated, three rotating cam-type latches on either side of the door capture posts mounted on the cargo door. A button adjacent to the door handle must be pressed before the handle can be rotated to open the door. A bellows behind the button is inflated when the aircraft is pressurized to prevent accidental unlatching and/or opening of the door. A placard adjacent to the window instructs the operator that the safety lock arm is in position around the bellows shaft that indicates a properly locked door. Pushing the red button adjacent to the window will illuminate the inside door mechanism. T3 F3 A red **CABIN DOOR** annunciator on the warning panel will illuminate if the door is not closed and all latches fully locked. R A **DOOR UNLOCKED** warning light on the warning annunciator panel will illuminate if the door is not closed and all latches fully locked. The cabin door opening is 21.5 inches wide by 46.0 inches high.

b. Cargo Door. A swing-up cargo door, hinged at the top, provides access for loading cargo or bulky items. Refer to Figure 2-8. The cargo door opening is 52.0 inches wide by 52.0 inches high. After initial opening force is applied, gas springs will completely open the cargo door automatically. The door is counter-balanced and will remain in the open position. A door support rod is used to hold the door in the open position, and to aid in overcoming the pressure of the gas spring assemblies when closing the door. Once closed, the gas springs apply a closing force to assist in latching the door. A rubber seal around the door seals the pressure vessel while in flight. The door locking mechanism is operated only from inside the aircraft, and is operated by two handles, one in the bottom forward portion of the door and the other in the upper aft portion of the door. When the upper aft handle is operated per placard instructions, cam-type latches (two on the forward side of the door and two on the aft side) rotate, capturing posts mounted on the fuselage side of the door opening. The bottom handle, when operated per placard instructions, actuates four pin-lug latches across the bottom of the door. A button on the upper aft handle must be pressed before the handle can be released to open or latch the door. A latching lever on the bottom handle must be lifted to release the handle before the lower latches can be opened. These act as additional aids in preventing accidental opening or unlatching of the door. The cabin and cargo doors are equipped with dual sensing circuits to provide the crew with remote indication of cabin/cargo door security. An annunciator, placarded **DOOR UNLOCKED** or **CABIN DOOR**, will illuminate if the cabin or cargo door is open and the battery switch is on. If the battery switch is off, the annunciator will illuminate only if the cabin/cargo door is not securely closed and latched. The cabin/cargo door sensing circuit receives power from the hot battery bus.

CAUTION

When operating the cargo door, ensure that the cabin door is closed and locked. Operating the cargo door while the cabin door is open may damage the door hinge and adjacent structure.

To prevent damage to the mechanism, avoid side loading of the gas springs.

(1) *Opening the Cargo Door*.

1. Handle Access Door (lower forward corner of door) – Unfasten and open.

2. Handle – Lift hook and move to **OPEN** position.

3. Handle Access Door – Secure.

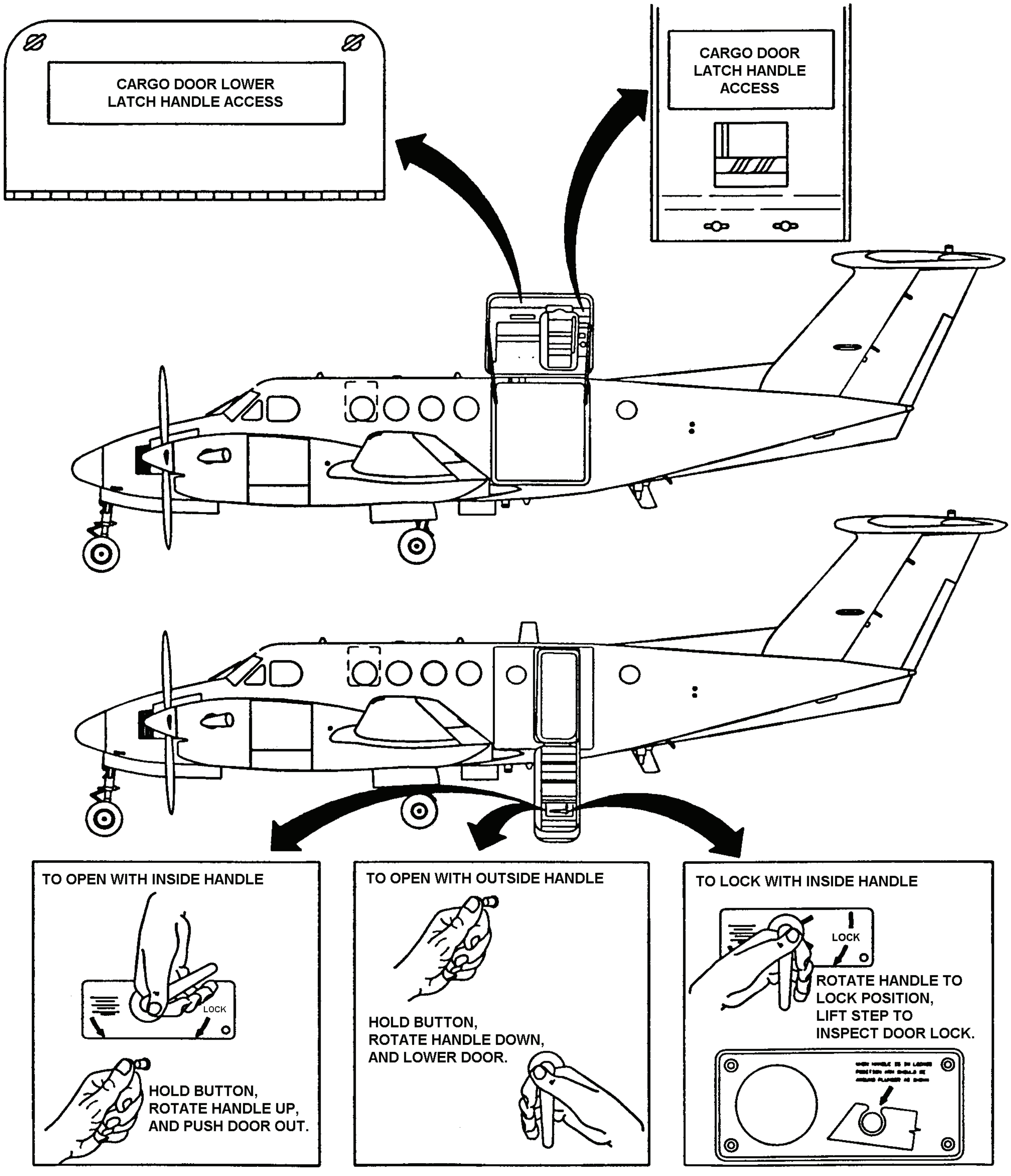


Figure 2-8. Cabin and Cargo Doors

4. Handle Access Door (upper aft corner of door) – Unfasten and open.

5. Handle – Press button and lift to **OPEN** position, then latch in place.

6. Handle Access Door – Secure.

7. Door Support Rod – Attach one end to cargo door ball stud (on forward side of door).

8. Support Rod Detent Pin – Check in place.

9. Cabin Doorsill Step – Push out and allow cargo door to swing open. Gas springs will automatically open the door.

10. Door Support Rod – Attach free end to ball stud on forward fuselage doorframe.

(2) Closing the Cargo Door.

CAUTION

To prevent damage to the mechanism, avoid side loading of the gas springs.

1. Door Support Rod – Detach from fuselage door frame ball stud, then firmly grasp free end of rod while exerting downward force to overcome the pressure of gas spring assemblies, then remove support rod from door as gas spring assemblies pass the over-center position.

2. Cargo Door – Pull closed, using finger hold cavity in fixed cabin doorstep.

3. Handle Access Door (upper aft corner of door) – Unfasten and open.

4. Handle – Press button and pull handle down until it latches in closed position.

5. Handle Access Door – Secure.

6. Handle Access Door (lower forward corner of door) – Unfasten and open.

7. Handle – Move to full forward position.

8. Safety Hook – Check locked in position by pulling aft on handle.

9. Handle Access Door – Secure.

c. Door Unlocked Annunciator. As a safety precaution, two flashing yellow **MASTER CAUTION** annunciators in the glareshield and a steadily illuminated yellow **DOOR UNLOCKED (R models)** caution annunciator or a red **CABIN DOOR (F3/T3)** warning annunciator indicate the cabin door is not closed and locked. The two 5-ampere circuit breakers, placarded **ANN POWER** and **ANN IND**, located on the right sidewall circuit breaker panel protect this circuit, Figure 2-6.

d. Cabin Emergency Exit Hatch. The cabin emergency hatch, placarded **EXIT – PULL**, is located on the right cabin sidewall just aft of the copilot's seat. The hatch may be released from the inside with a pull-down handle. A flush-mounted, pull out handle allows the hatch to be released from the outside. The hatch is of the non-hinged plug type that removes completely from the frame when the latches are released. The hatch can be key locked from the inside to prevent opening from the outside. The inside handle will unlatch the escape hatch, whether or not it is locked, by overriding the locking mechanism. The keylock should be unlocked prior to flight to allow removal of the escape hatch from the outside in the event of an emergency. The key remains in the lock when the hatch is locked and can be removed only when the hatch is unlocked. The key slot is in the vertical position when the hatch is unlocked. Removal of the key from the lock before flight assures the pilot that the hatch can be removed from the outside if necessary.

2-10. WINDOWS.

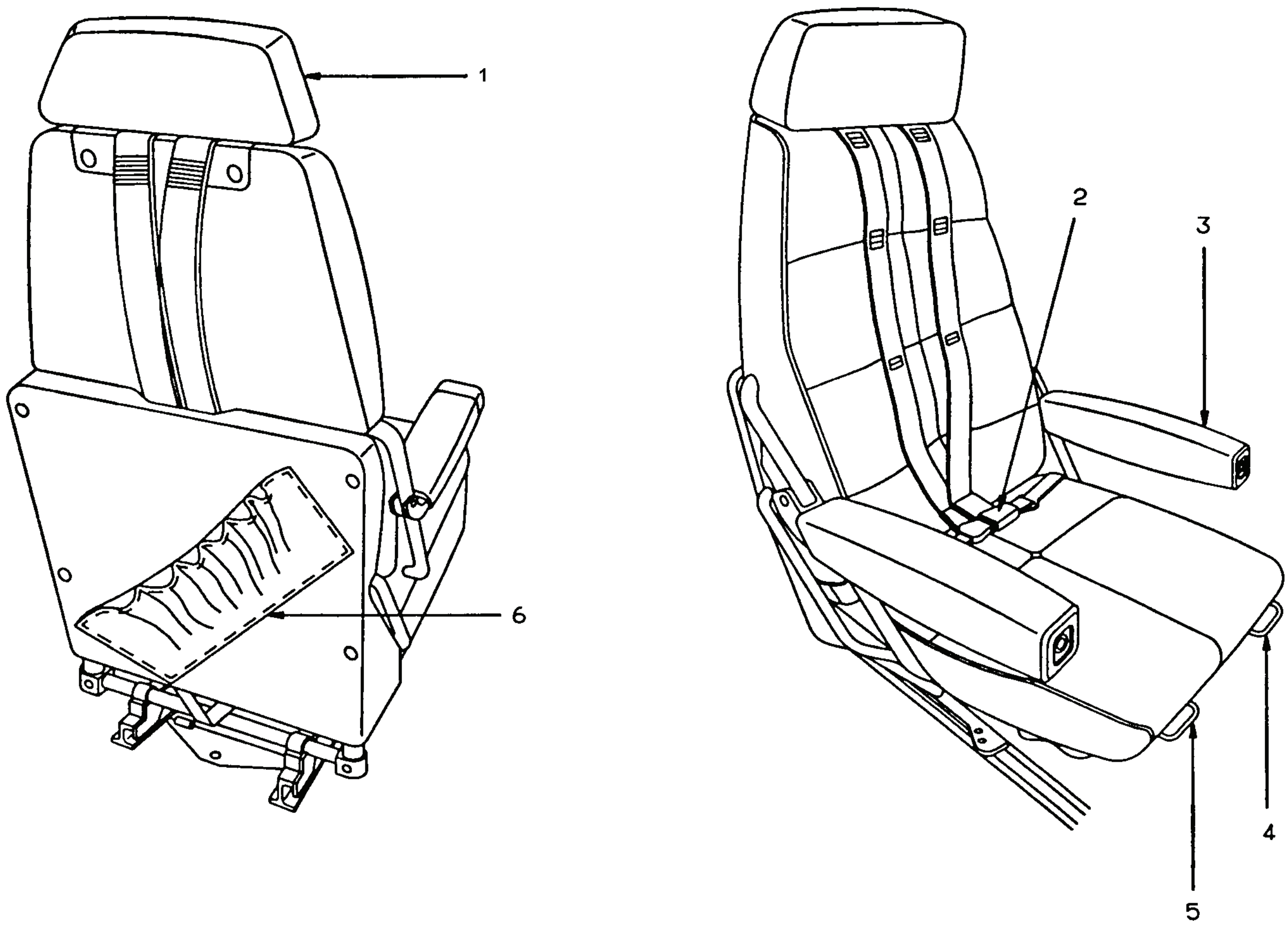
a. Cockpit Windows. The pilot and copilot have side windows, a windshield, and storm windows, which provide visibility from the cockpit. The storm windows may be opened on the ground or during unpressurized flight.

b. Cabin Windows. The outer cabin windows, constructed of two-ply stretched acrylic, are of the pressure type and are an integral part of the pressure vessel. Each cabin window is equipped with a pull down shade that allows individual adjustment of outside light transmission.

2-11. SEATS.

a. Pilot's and Copilot's Seats. The controls for vertical height adjustment and fore and aft travel are located under each seat. Refer to Figure 2-9. The forward and aft adjustment handle is located beneath the lower front inboard corner of each seat. Pulling up on the handle allows the seat to move fore or aft. The height adjustment handle is located beneath the lower front outboard corner of each seat. Pulling up on the handle allows the seat to move up and down. Both seats have moveable headrests and armrests that will raise and lower for access to the cockpit. Handholds on either side of the overhead panels and a foldaway protective pedestal step are provided for pilot and copilot entry into the cockpit. For the storage of maps and the operator's manual, pilot's and copilot's seats have an inboard-slanted, expandable pocket affixed to the lower portion of the seat back. Pocket openings are held closed by shock cord tension.

b. Pilot's and Copilot's Seat Belts and Shoulder Harnesses. The pilot's and copilot's seats are each equipped with a lap-type seat belt and shoulder harness connected to an inertia reel. The shoulder harness belt is of the Y configuration with the single strap being contained in an inertia reel attached to the base of the seat back. The two straps are worn with one strap over each shoulder and fastened by metal loops into the seat belt buckle. The inertia reel keeps the harness snug but will allow normal movement required during flight operations. The inertia reel is designed with a locking device that will secure the harness in the event of sudden forward movement or an impact action.



1. **Adjustable Headrest**
2. **Seat Belt/Shoulder Harness Buckle**
3. **Moveable Armrest**
4. **Seat Height Adjustment (Pilot) Fore and Aft Adjustment (Copilot)**
5. **Seat Fore and Aft Adjustment (Pilot) Height Adjustment (Copilot)**
6. **Expandable Map Pocket**

Figure 2-9. Pilot's and Copilot's Seats

Section II. EMERGENCY EQUIPMENT

2-12. DESCRIPTION.

The equipment covered in this section includes all emergency equipment, except that which forms part of a complete system. For example, landing gear system, etc. Chapter 9 describes the operation of emergency exits and location of all emergency equipment.

2-13. HAND-OPERATED FIRE EXTINGUISHER.

WARNING

Avoid repeated or prolonged exposure to high concentrations of monobromo-trifluoromethane (CF_3Br) or decomposition products. The liquid shall not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns because of its very low boiling point.

One hand-operated fire extinguisher is mounted below the pilot's seat and a second extinguisher is located in the left cabin sidewall, aft of the cabin door. They are of the monobromotrifluoromethane (CF_3Br) type. Each extinguisher is charged to a pressure of 150 to 170 psi and emits a forceful stream. Use an extinguisher with care within the limited area of the cabin to avoid severe splashing.

NOTE

Engine fire extinguisher systems are described in Section III.

Section III. ENGINES AND RELATED SYSTEMS

2-14. ENGINES.

Two PT6A-42 turboprop engines, rated at 850 SHP each, power the aircraft. Refer to Figure 2-10. Each engine is equipped with a hydraulically controlled, reversible, constant-speed, four-blade, full-feathering propeller. The engines are reverse-flow free turbines, and each employs a three-stage axial compressor and a single-stage centrifugal compressor in combination, driven by the gas generator turbine. The gas generator turbine and the two power turbines are in line and have opposite rotations. The power turbines are connected through planetary reduction gearing to a flanged propeller shaft. The oil tank, filler cap and dipstick are an integral part of the engine.

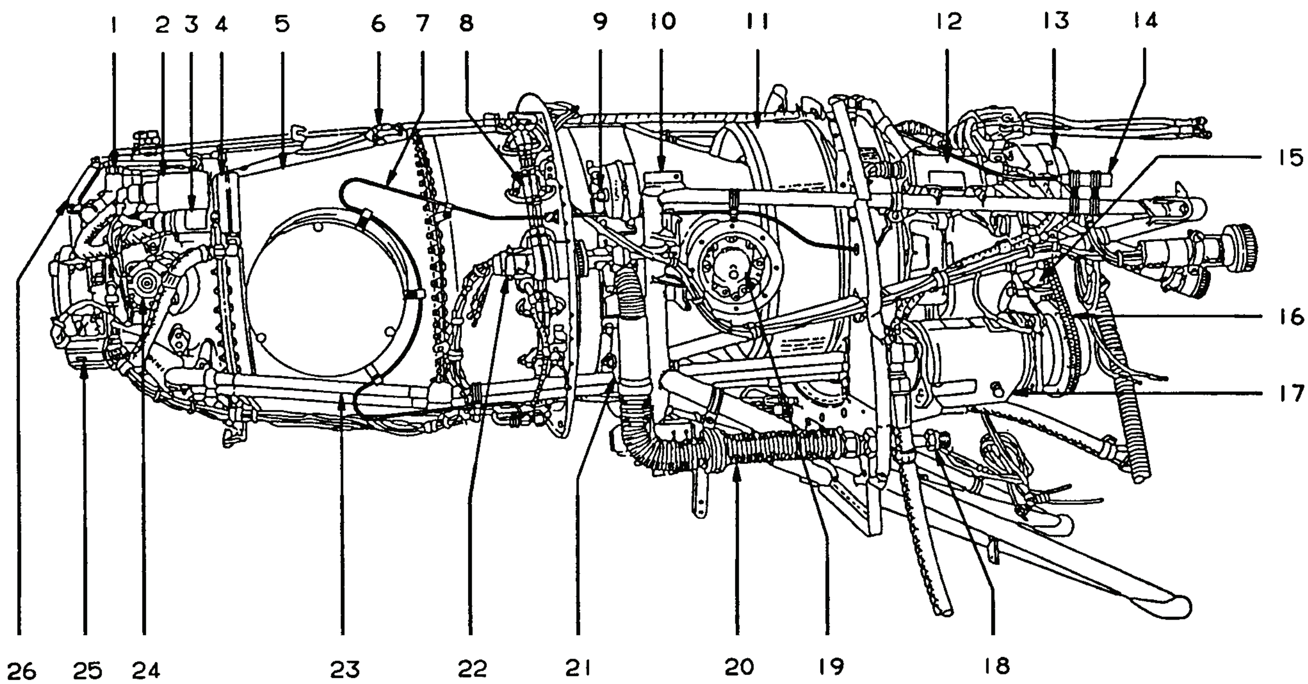
NOTE

The engine anti-ice system (ice vanes) should be on (extended) for all ground operations to minimize ingestion of ground debris. Turn off engine anti-ice (retract ice vanes) to maintain engine temperatures within limits.

The ram air supply enters the lower portion of the nacelle and is drawn in through the aft protective screens. The air is then routed into the compressor. After the air is compressed, it is forced into the annular combustion chamber and mixed with fuel that is sprayed in through 14 nozzles mounted around the gas generator case. A capacitance discharge ignition unit and two spark igniter plugs are used to start combustion. After combustion, the exhaust passes through the compressor turbine and two stages of power turbines, then is routed through two exhaust ports near the front of the engine. A pneumatic fuel control system schedules fuel flow to maintain power set by the gas generator **POWER** lever. The accessory drive at the aft end of the engine provides power to drive the fuel pumps, fuel control, oil pump, refrigerant compressor (right engine), starter/ generator, and the tachometer generator. The reduction gearbox forward of the power turbine provides gearing for the propeller and drives the propeller tachometer generator, the propeller overspeed governor, and the propeller primary governor.

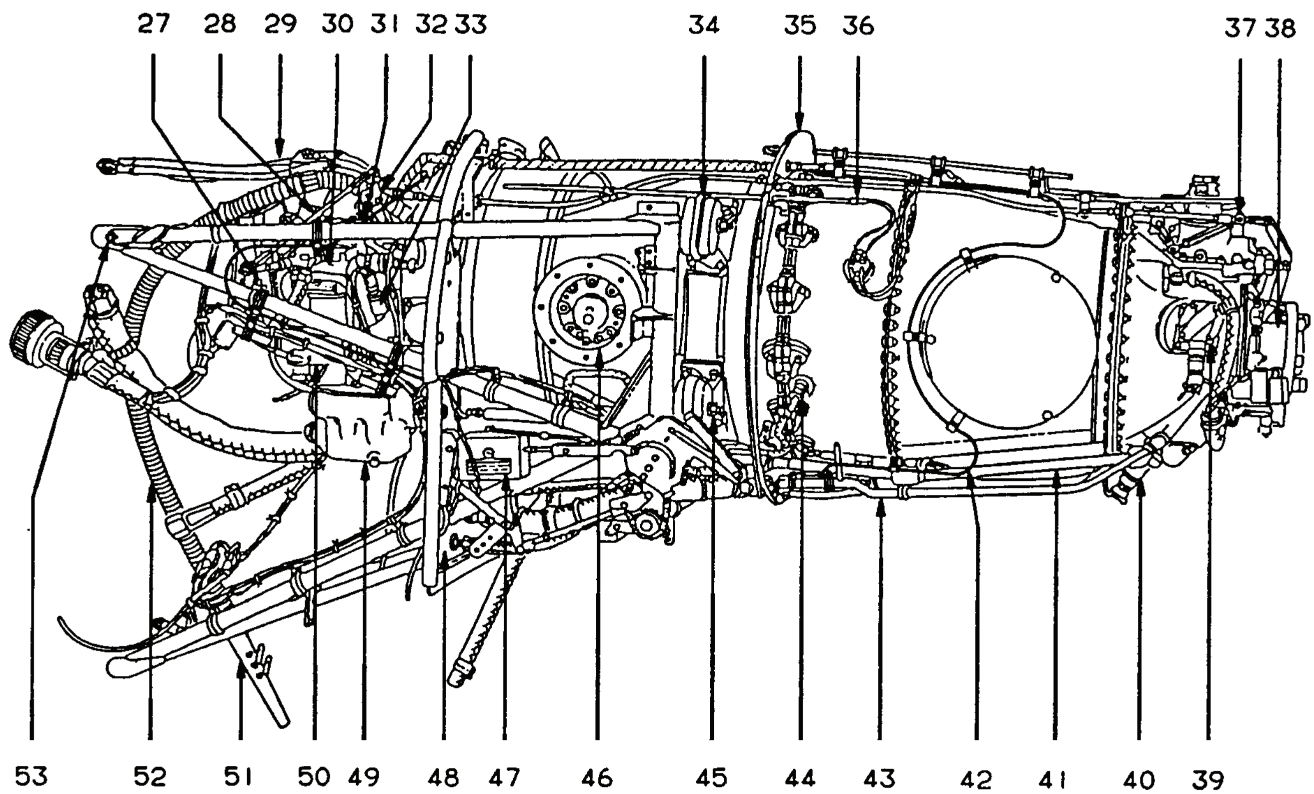
2-15. ENGINE COMPARTMENT COOLING.

The forward engine compartment, including the accessory section, is cooled by air that enters around the exhaust stack cutouts and through the gap between the propeller spinner and forward cowling, and exhausts through louvers in the upper forward and aft cowling.



1. Primary Prop Governor
2. Torque Pressure Transmitter
3. Torque Pressure Switch
4. Torque Pressure Manifold
5. Exhaust Duct
6. ITT Temperature Probe
7. Fire Detector Tube
8. Fuel Flow Divider Manifold
9. Engine Mount Bolt
10. Engine Mount Truss Assembly
11. Engine Air Intake Screen
12. Ignition Exciter
13. Starter-Generator
14. Fire Detector
15. Fuel Boost Pump
16. Air Conditioner Compressor Drive
17. Air Conditioner Compressor (#2 Engine Only)
18. Bleed Air Adapter
19. Bleed Air Valve (Low Pressure)
20. P3 Air Line
21. Engine Mount
22. Ignition Exciter Plug
23. Dual Scavange Oil Tubes
24. Overspeed Governor
25. Prop Deice Brush Block Bracket
26. Prop Reverse Linkage Lever

Figure 2-10. Engine (Sheet 1 of 2)



27. Fuel Control Unit
28. Fuel Control Unit Control Rod
29. Starter Generator Leads
30. Engine Driven Fuel Pump
31. Power Control Lever
32. Prop Interconnect Linkage (Aft)
33. Oil Pressure Transducer
34. Engine Mount
35. Fireshield
36. Trim Resistor Thermocouple
37. Prop Interconnect Linkage (Fore)
38. Prop Shaft
39. Prop Tach Generator (N_2)
40. Chip Detector
41. Oil Pressure Tube
42. Fire Detector Tube
43. Fire Extinguisher Line (R models)
44. Ignition Exciter Plug
45. Engine Mount Bolt
46. Bleed Air Valve (High Pressure)
47. Linear Actuator
48. Engine Baffle And Seal Assembly
49. Fuel/Oil Heater
50. Tach Generator (N_1)
51. Drain Manifold
52. Overhead Breather Tube
53. Engine Truss Mounting Bolt

Figure 2-10. Engine (Sheet 2 of 2)

2-16. AIR INDUCTION SYSTEMS – GENERAL.

Each engine and oil cooler receives ram air ducted from separate air inlets located within the lower section of the forward nacelle. Induction system components protect the power plant from icing and reduce the possibility of foreign object damage.

2-17. FOREIGN OBJECT DAMAGE CONTROL.

The engine has an integral air inlet screen designed to obstruct objects large enough to damage the compressor.

NOTE

The engine anti-ice system (ice vanes) should be on (extended) for all ground operations to minimize ingestion of ground debris. Turn off engine anti-ice (retract ice vanes) to maintain engine temperatures within limits.

2-18. ENGINE ICE PROTECTION SYSTEMS R.

a. Inertial Separator. An inertial separation system is built into each engine air inlet to prevent moisture particles from entering the engine inlet plenum under icing conditions. A movable vane and a bypass door are lowered into the air stream when operating in visible moisture at 5 °C or colder, by energizing electrical actuators with the switches, placarded **LEFT** and **RIGHT ENGINE ANTI-ICE ON / OFF**, located on the pilot's subpanel. The system incorporates an electrical backup system that operates identically to the main system. The back-up ice vane system is controlled by two switches placarded **LEFT** and **RIGHT ACTUATOR MAIN / STANDBY**, located on the pilot's subpanel. If the main system fails, placing the switch in the **STANDBY** position will allow use of the back-up system. Electrical protection is provided through two 5-ampere circuit breakers placarded **LEFT** and **RIGHT MN ENG ANTI-ICE** and two 5-ampere circuit breakers, placarded **LEFT** and **RIGHT STBY ENG ANTI-ICE**, located on the right sidewall circuit breaker panel.

b. Engine Ice Protection Systems Operation. The vane deflects the ram airflow slightly downward to introduce a sudden turn in the airflow to the engine. Because of their greater momentum the particles continue undeflected and are discharged overboard.

Once the ice vane system is actuated, the extended position of the vane and bypass door is indicated by green annunciators, placarded **L** and **R ENG ANTI-ICE**, located on the caution/advisory panel. If for any reason the vane(s) do not attain the selected position within 33 seconds, a yellow **L** or **R ENG ICE FAIL** annunciator will illuminate on the caution/ advisory panel. In this event, the appropriate **LEFT** or **RIGHT ACTUATOR** switch should be placed in the **STANDBY** position. Once the vane is successfully positioned, using the standby system, the yellow annunciator(s) will extinguish and the applicable green **LEFT** or **RIGHT ENG ANTI-ICE** annunciator(s) will illuminate.

c. Engine Anti-Ice System.

(1) Air Inlet. A small duct, which faces into the exhaust flow in the left exhaust stack of each engine, diverts a small portion of the engine exhaust gases to the engine air inlet lip. The gases are circulated through the engine air inlet lip and then exhausted through a duct in the right exhaust stack. The continuous flow of hot engine exhaust gases heats the engine air inlet lip, preventing the formation of ice.

(2) Fuel Heater. An oil-to-fuel heat exchanger, located in the engine accessory case, operates continuously and automatically to heat the fuel sufficiently to prevent ice from collecting in the fuel control unit.

(3) Fuel Control Heat. The engine fuel control unit is protected from icing by the fuel control heater, which is actuated by movement of its respective condition lever. The fuel control heater circuit breaker, placarded **LEFT** and **RIGHT FUEL CONTROL HEAT**, is located on the right sidewall circuit breaker panel.

2-19. ENGINE ICE PROTECTION SYSTEMS T3 F3 .

a. Ice Vanes (Inertial Separator System*).* An inertial separation system is built into each engine air inlet to prevent moisture particles from entering the engine inlet plenum under icing conditions. A movable vane and a bypass door are lowered into the airstream when operating in visible moisture at an OAT or SAT of +5°C or colder (IOAT or TAT of +10°C or colder for in flight) with the switches, placarded **ICE VANE EXTEND / RETRACT**, located on the lower left subpanel.

The vane deflects the ram airstream slightly downward to induce a sudden turn in the airstream to the engine causing the moisture particles to continue undeflected, because of their greater momentum, and to be discharged overboard.

While in the icing flight mode, the extended position of the vane and bypass door is indicated by green annunciator lights, **L ICE VANE EXT** and **R ICE VANE EXT**.

When ice protection is not required, the vane and bypass door are retracted out of the airstream by placing the ice vane switches in the **RETRACT** position. The green annunciator lights will extinguish. Retraction should be accomplished at +15 °C and above to assure adequate oil cooling. The vanes should be either extended or retracted; there are no intermediate positions.

If for any reason the vane does not attain the selected position within 15 seconds, a yellow **L ICE VANE** or **R ICE VANE** light illuminates on the caution/advisory panel. In this event, a mechanical backup system is provided, and is actuated by pulling the T-handles just below the pilot's subpanel, placarded **ICE VANE EMERGENCY**.

b. Manual Extension Pull Left Eng / Right Eng. Airspeed reduction may be necessary to extend the ice vanes manually. Once extended, normal airspeed may be resumed.

CAUTION

Once the manual override system has been engaged (i.e., anytime the manual ice vane T-handle has been pulled), do not attempt to electrically extend or retract the ice vanes, even if the T-handle has been pushed back in, until the override linkage in the engine compartment has been properly reset on the ground.

When the vane is successfully positioned with the manual system, the yellow annunciator lights will extinguish. The vane may then be retracted or extended with the manual system. During manual system use, the electric switch position must match the manual handle position for a correct annunciator readout.

2-20. ENGINE FUEL CONTROL SYSTEM.

a. Description. The basic fuel system for each engine consists of an engine driven fuel pump, a fuel control unit, a fuel flow divider, a dual fuel manifold, 14 fuel nozzles, and a purge system. The fuel purge system forces residual fuel from the manifolds to the combustion chamber where it is consumed.

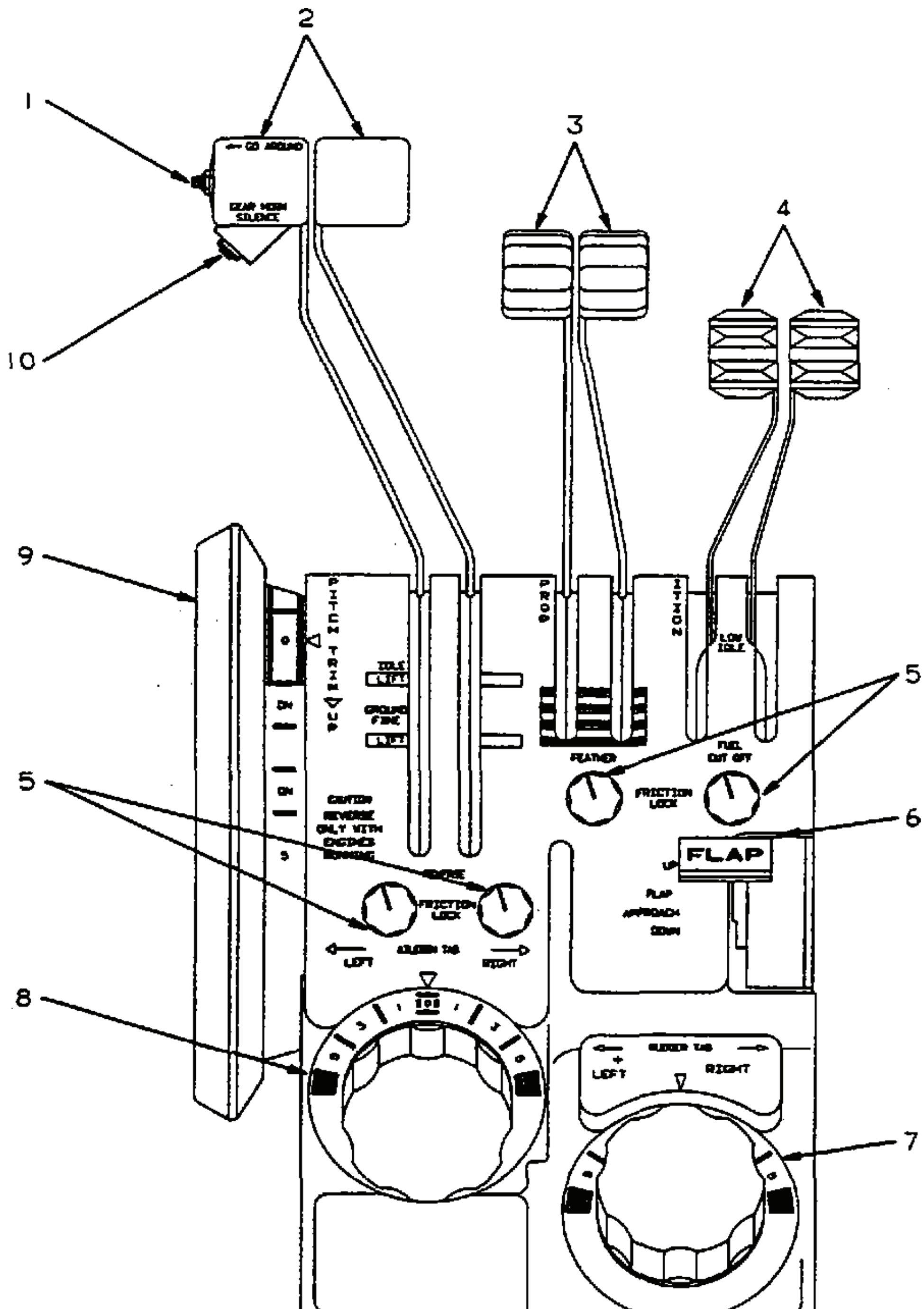
b. Fuel Control Unit. The fuel control unit is mounted on the accessory case of the engine. The unit is a hydro-pneumatic metering device that determines the proper fuel flow schedule required for the engine to produce the amount of power requested by the relative position of the associated **POWER** lever. The control of developed engine power is accomplished by adjusting the speed of the engine-gas generator (N_1). N_1 speed is controlled by varying the amount of fuel injected into the combustion chamber through the fuel nozzles. Engine shutdown is accomplished by moving the appropriate **CONDITION** lever to the full aft **FUEL CUTOFF** position, which shuts off the fuel supply.

2-21. POWER LEVERS.

CAUTION

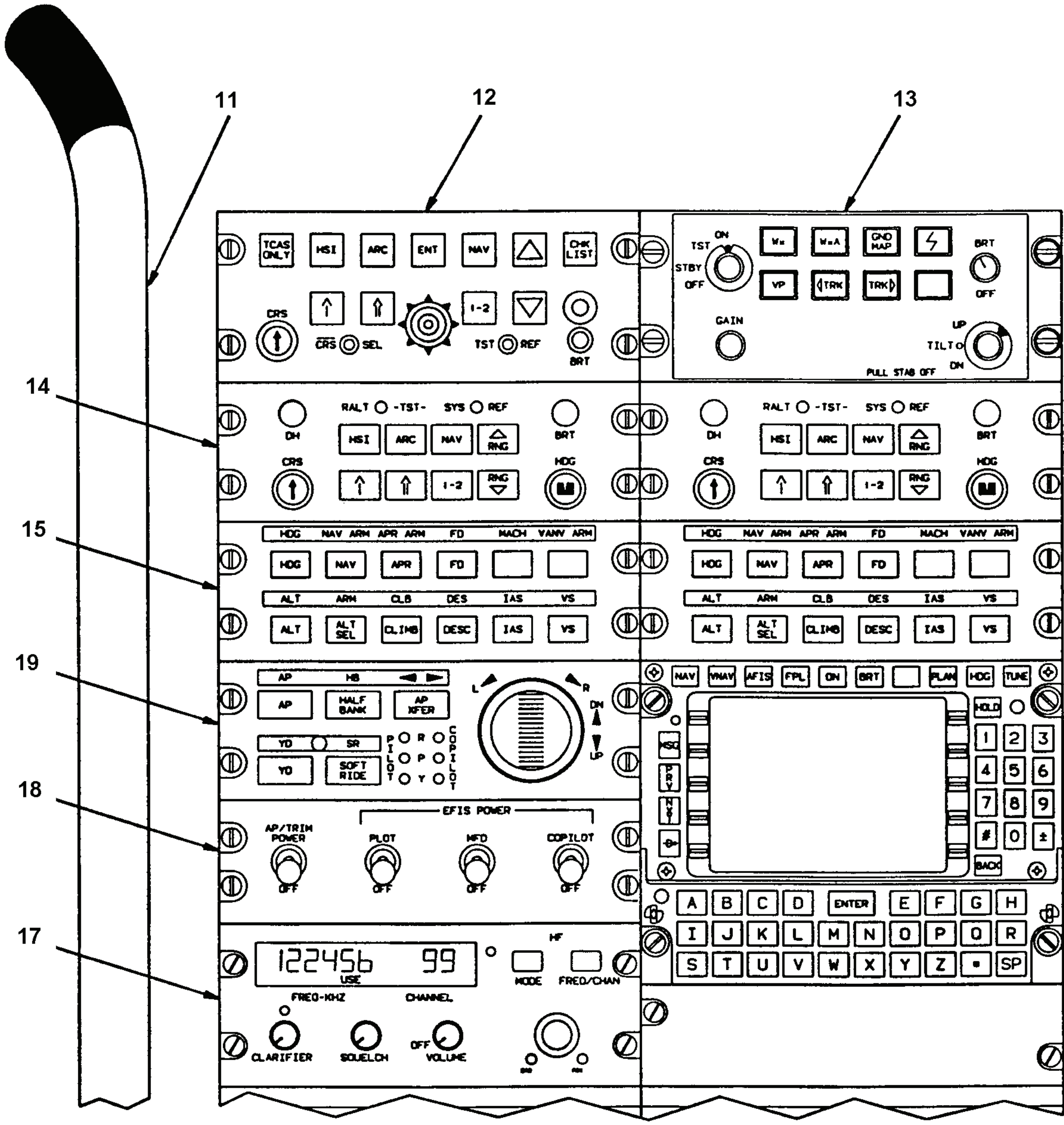
Moving the POWER lever below the flight idle gate without the associated engine running may result in damage to the reverse mechanism linkage.

The two **POWER** levers are located on the control pedestal and are placarded **POWER**. Refer to Figure 2-11. These levers regulate power in the reverse, idle and forward ranges, operating so that forward movement increases engine power. Power control is accomplished through adjustment of the N_1 speed governor in the fuel control unit. Power is increased when N_1 RPM is increased. The **POWER** levers also control propeller reverse pitch. Distinct movement (pulling up and then aft on the **POWER** lever) by the pilot is required for operation in the ground fine and reverse ranges. Forward lever travel range is designated **INCR** (increase), supplemented by an arrow pointing forward. **R** Lever travel range is marked **IDLE**, **LIFT**, **GROUND FINE**, **LIFT**, and **REVERSE**. **T3** **F3** Lever travel range is marked **IDLE**, **LIFT**, and **REVERSE**. A placard below the lever slots reads: **CAUTION – REVERSE ONLY WITH ENGINES RUNNING.**



1. GO AROUND Switch
2. Power Levers
3. Propeller Levers
4. Condition Levers
5. FRICTION LOCK Knobs
6. FLAP Switch
7. Rudder Trim Control
8. Aileron Trim Control
9. Elevator Trim Control
10. GEAR HORN SILENCE Switch

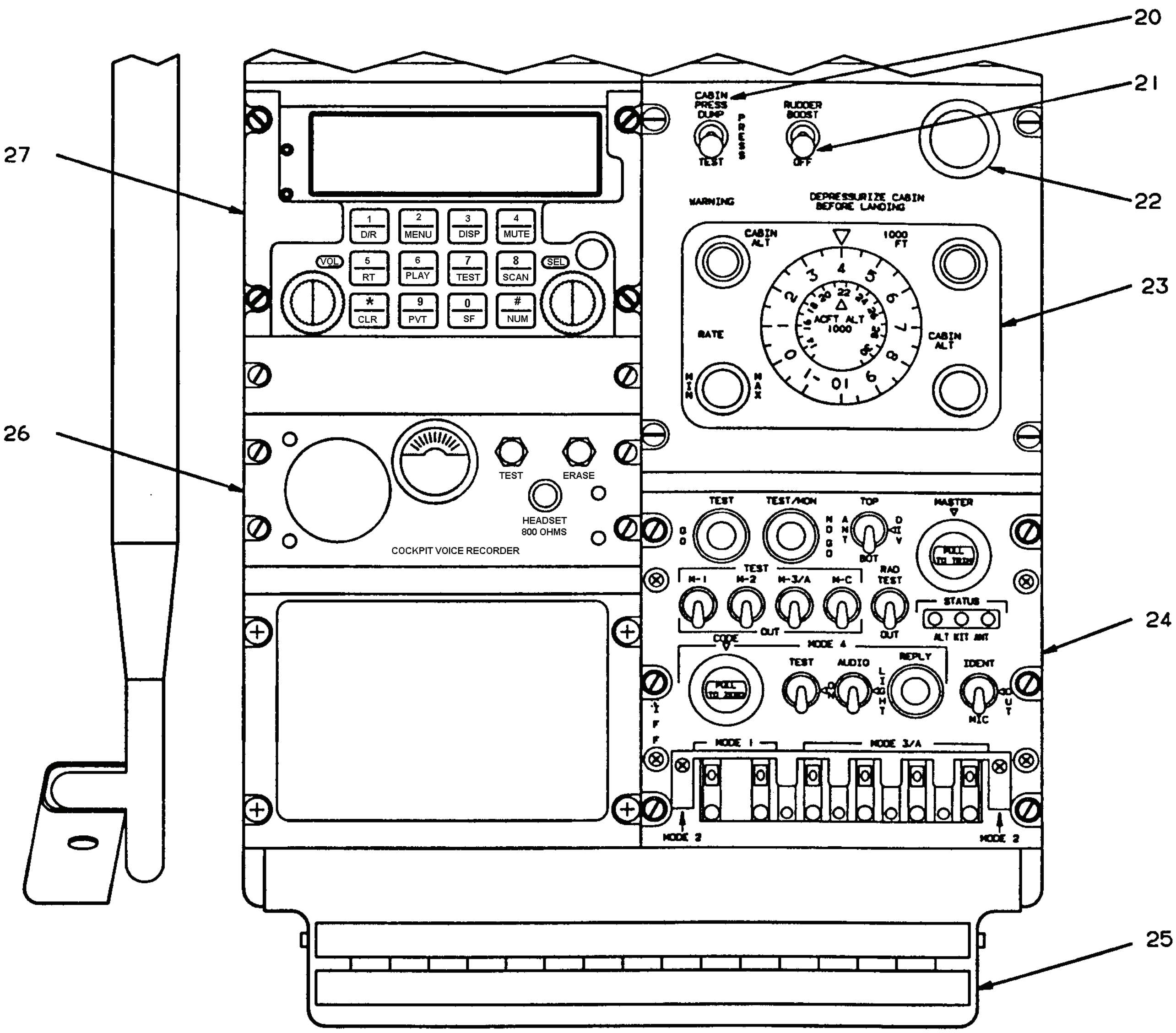
Figure 2-11. Control Pedestal and Pedestal Extension **R** *(Sheet 1 of 7)*



PEDESTAL EXTENSION (FORWARD HALF)

11. Alternate Landing Gear Extension Pump Handle
12. Multifunction Display Control Panel
13. Weather Radar Control Panel
14. EFIS Control Panel
15. Flight Director Mode Selector
16. Flight Management System Control Unit
17. HF Transceiver Control Unit
18. Autopilot / Electric Trim / EFIS Power Switch Panel
19. Autopilot Controller

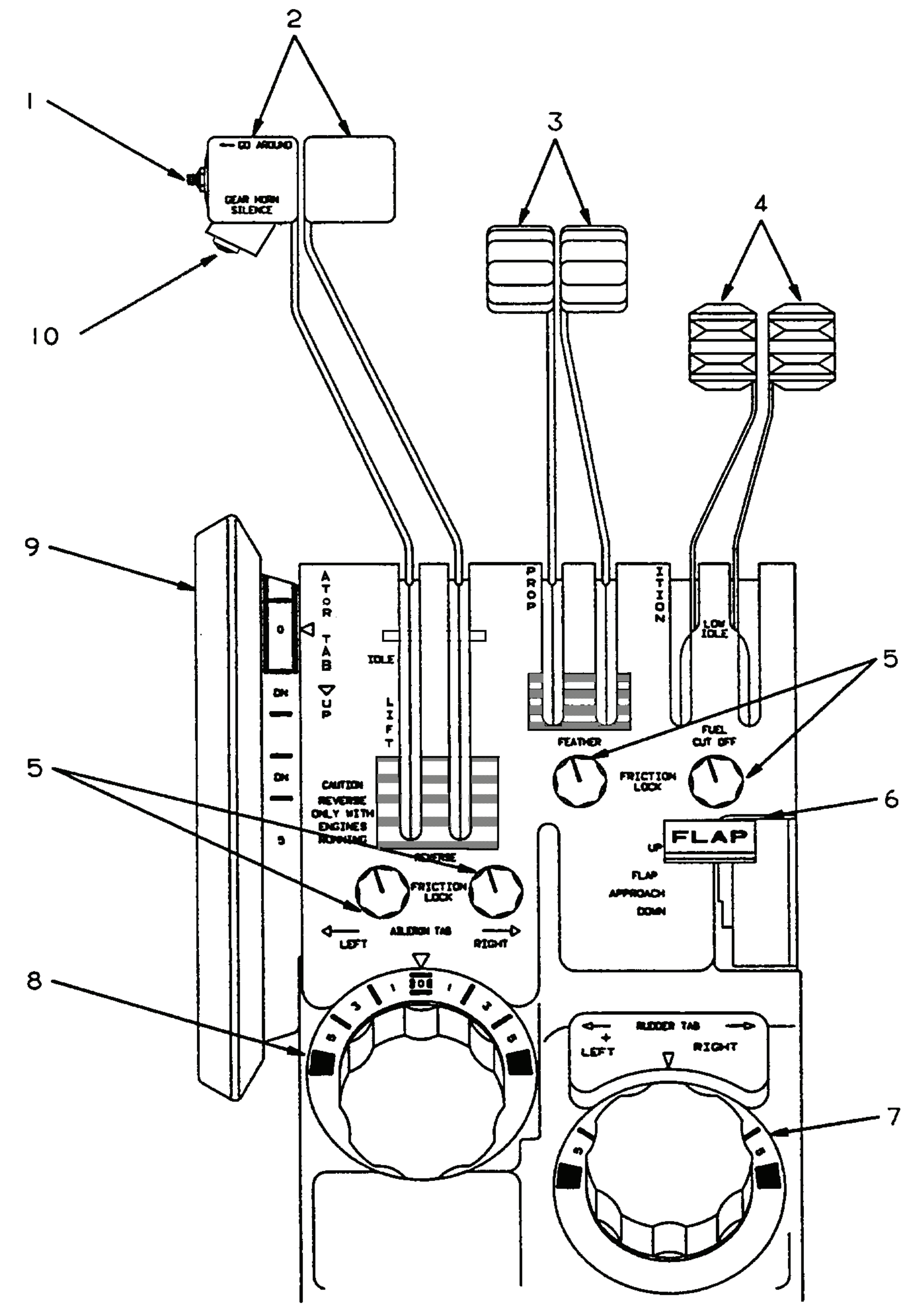
Figure 2-11. Control Pedestal and Pedestal Extension **R** *(Sheet 2 of 7)*



PEDESTAL EXTENSION (AFT HALF)

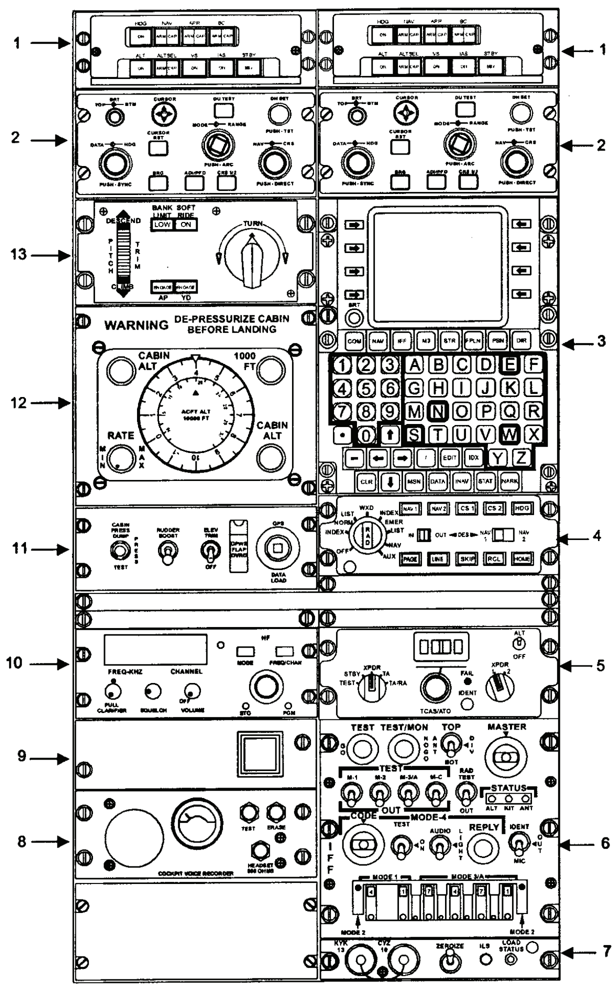
20. Cabin Pressurization Switch
21. Rudder Boost Switch
22. Cigarette Lighter
23. Cabin Pressurization Controller
24. Transponder Control Panel
25. Assist Step
26. Cockpit Voice Recorder Control Unit
27. AM/FM (VHF/UHF) Transceiver Control Unit

Figure 2-11. Control Pedestal and Pedestal Extension **R** *(Sheet 3 of 7)*



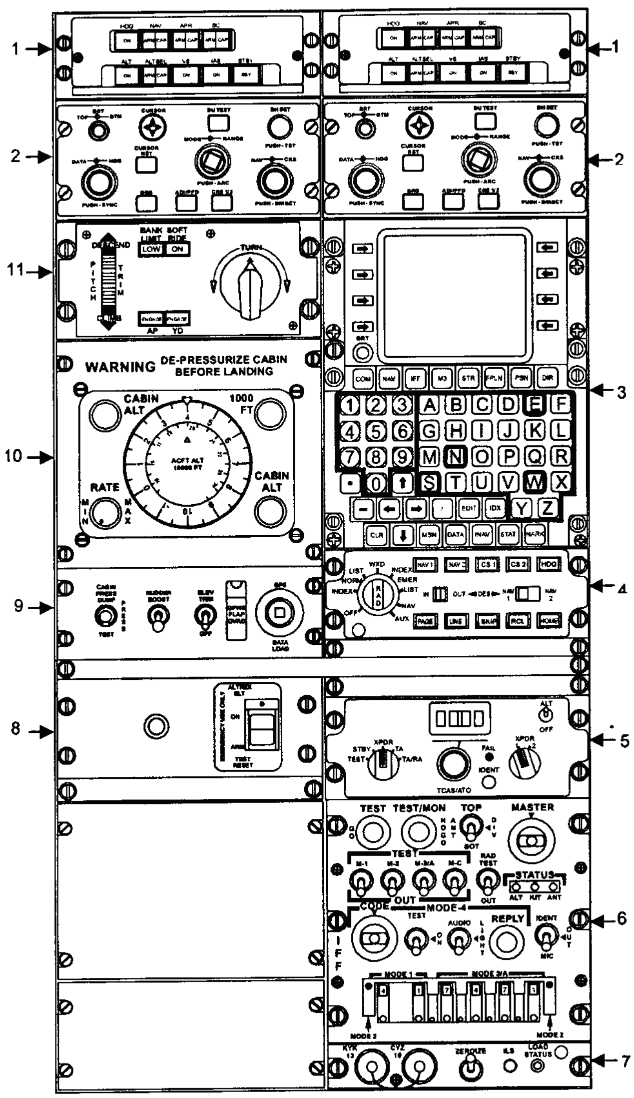
1. Go Around Switch
2. Power Levers
3. Propeller Levers
4. Condition Levers
5. Friction Lock Knobs
6. Flap Switch
7. Rudder Trim Control
8. Aileron Trim Control
9. Elevator Trim Control
10. Landing Gear Warning Horn Silence Switch (T3 and modified F3)

Figure 2-11. Control Pedestal and Pedestal Extension T3 F3 (Sheet 4 of 7)



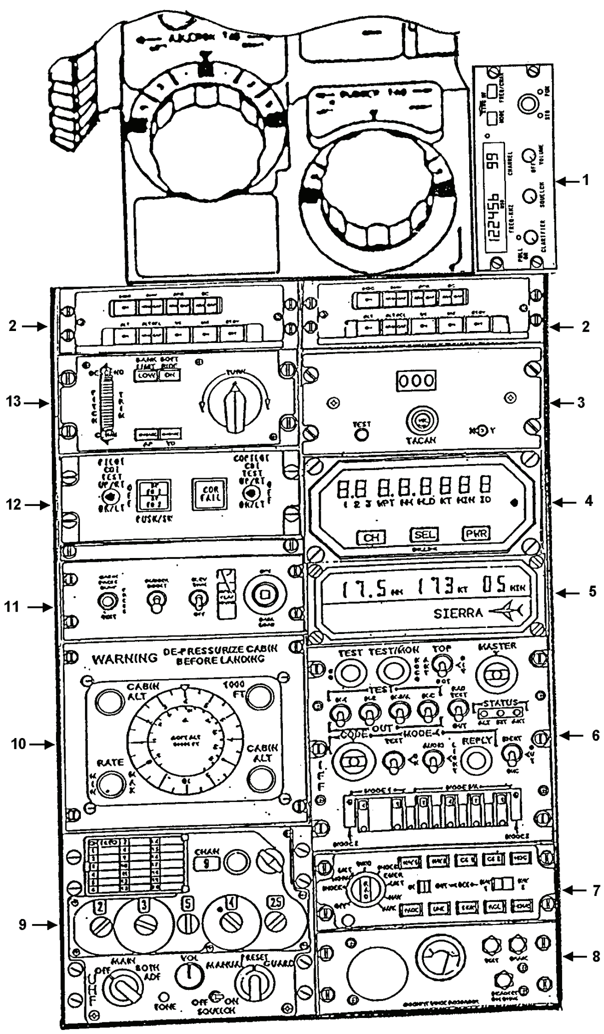
1. Flight Director/Mode Selector
2. MFD Control Panel
3. FMS-800 Control Panel Display Unit
4. Data Nav Control Panel
5. TCAS Control Panel
6. Transponder Control Panel
7. Fill Panel
8. Cockpit Voice Recorder Control Panel
9. Crash Data Recorder Annunciator
10. HF Radio Control Panel
11. Miscellaneous Switch Panel
12. Cabin Pressurization Controller
13. Autopilot Control Panel

Figure 2-11. Control Pedestal and Pedestal Extension **T3** **OSA** *(Sheet 5 of 7)*



1. Flight Director/Mode Selector
2. MFD Control Panel
3. FMS-800 Control Panel Display Unit
4. Data Nav Control Panel
5. TCAS Control Panel
6. Transponder Control Panel
7. Fill Panel
8. ELT Control Panel
9. Miscellaneous Switch Panel
10. Cabin Pressurization Controller
11. Autopilot Control Panel

Figure 2-11. Control Pedestal and Pedestal Extension **T3** **ANG** *(Sheet 6 of 7)*



1. HF Control Panel
2. Flight Director/Mode Selector
3. TACAN Control Panel
4. DME Indicator
5. TACAN Indicator
6. Transponder Control Panel
7. Data Nav Control Panel
8. Cockpit Voice Recorder Control Panel
9. UHF Radio Control Panel
10. Cabin Pressurization Controller
11. Miscellaneous Switch Panel
12. AP/FD Transfer Panel
13. Autopilot Control Panel

Figure 2-11. Control Pedestal and Pedestal Extension **F3** **OSA** *(Sheet 7 of 7)*

2-22. CONDITION LEVERS.

The two **CONDITION** levers are located on the control pedestal. Each lever starts and stops the fuel supply, and controls the idle speed for its respective engine. The levers have three placarded positions: **FUEL CUTOFF**, **LOW IDLE**, and **HIGH IDLE**. In the **FUEL CUTOFF** position, the **CONDITION** lever controls the cutoff function of its engine-mounted fuel control unit. From **LOW IDLE** to **HIGH IDLE**, they control the governors of the fuel control units to establish minimum fuel flow levels. **LOW IDLE** position sets the fuel flow rate to attain approximately 61% N_1 and **HIGH IDLE** position sets the rate to attain approximately 70% N_1. The **POWER** lever for the corresponding engine can select N_1 from the respective idle setting, up to maximum power. An increase in low idle N_1 will be experienced at high field elevation.

2-23. FRICTION LOCK KNOBS.

Friction drag of the engine and propeller control levers is adjusted, as applicable, by four friction lock knobs. The friction lock knobs, placarded **FRICTION LOCK**, are located on the control pedestal. One knob is below the propeller levers, one is below the **CONDITION** levers, and two are below the **POWER** levers. When a knob is rotated clockwise, the friction increases opposing movement of the affected lever as set by the pilot. Counterclockwise rotation of the knob will decrease friction, thus permitting free and easy lever movement.

2-24. ENGINE FIRE DETECTION SYSTEM.

a. Description R . A fire detection system is installed to provide an immediate warning in the event of a fire or overtemperature in each engine compartment. Refer to Figure 2-12. The system consists of a temperature sensing cable for each engine, two red warning annunciators, a test switch on the copilot's left subpanel, and a 5-ampere circuit breaker, placarded **FIRE DET** on the right sidewall circuit breaker panel. The test switch, placarded **TEST SWITCH ENG FIRE SYS EXT R / L** and **DET R / L**, is located on the copilot's subpanel. When the test switch is placed in the **DET L** or **R** position, the corresponding **L ENG FIRE** or **R ENG FIRE** annunciator on the warning annunciator panel and the **MASTER WARNING** annunciators will illuminate and flash.

NOTE

The system may be tested on the ground or in flight.

When a fire has been extinguished, if the integrity of the system has not been destroyed, the system will reset itself.

b. Description T3 F3 OSA . A pneumatic fire detection system, Figure 2-13, is installed to provide an immediate warning in the event of a fire or over-temperature in the engine compartment. The main element of the system is a temperature sensing cable routed continuously throughout either engine compartment, terminating in a responder unit. The responder unit is mounted in each engine accessory area on the upper left hand engine truss just forward of the engine firewall. The responder unit contains two sets of contacts: a set of integrity switch contacts for continuity test functions of the fire detection circuitry, and a set of alarm switch contacts which completes the circuit to activate the fire warning system when the detector cable senses an over-temperature condition in critical areas around the engine.

The sensor cable consists of an outer tube filled with an inert gas, and an inner hydride core that is filled with an active gas. The gases within the tube form a pressure barrier that keeps the contacts of the responder integrity switch closed for fire alarm continuity test functions. As the temperature around the sensing cable increases, the gases within the tube begin to expand. When the pressure from the expanding gases reaches a preset point, the contacts of the responder alarm switch close, causing the respective **ENG FIRE** annunciator and flashing **MASTER WARNING** lights to illuminate.

The fire warning system consists of two red lenses placarded **L ENG FIRE** and **R ENG FIRE**, located in the warning annunciator panel, two red **MASTER WARNING** lights located on opposite sides of the glareshield, and two responder units with pneumatic sensors in the engine compartments.

An integrity switch that monitors the system is held in the closed position. If the detector should develop a leak, the loss of gas pressure would allow the integrity switch to open and signal a lack of detector integrity. The system then will not operate during the system test function.

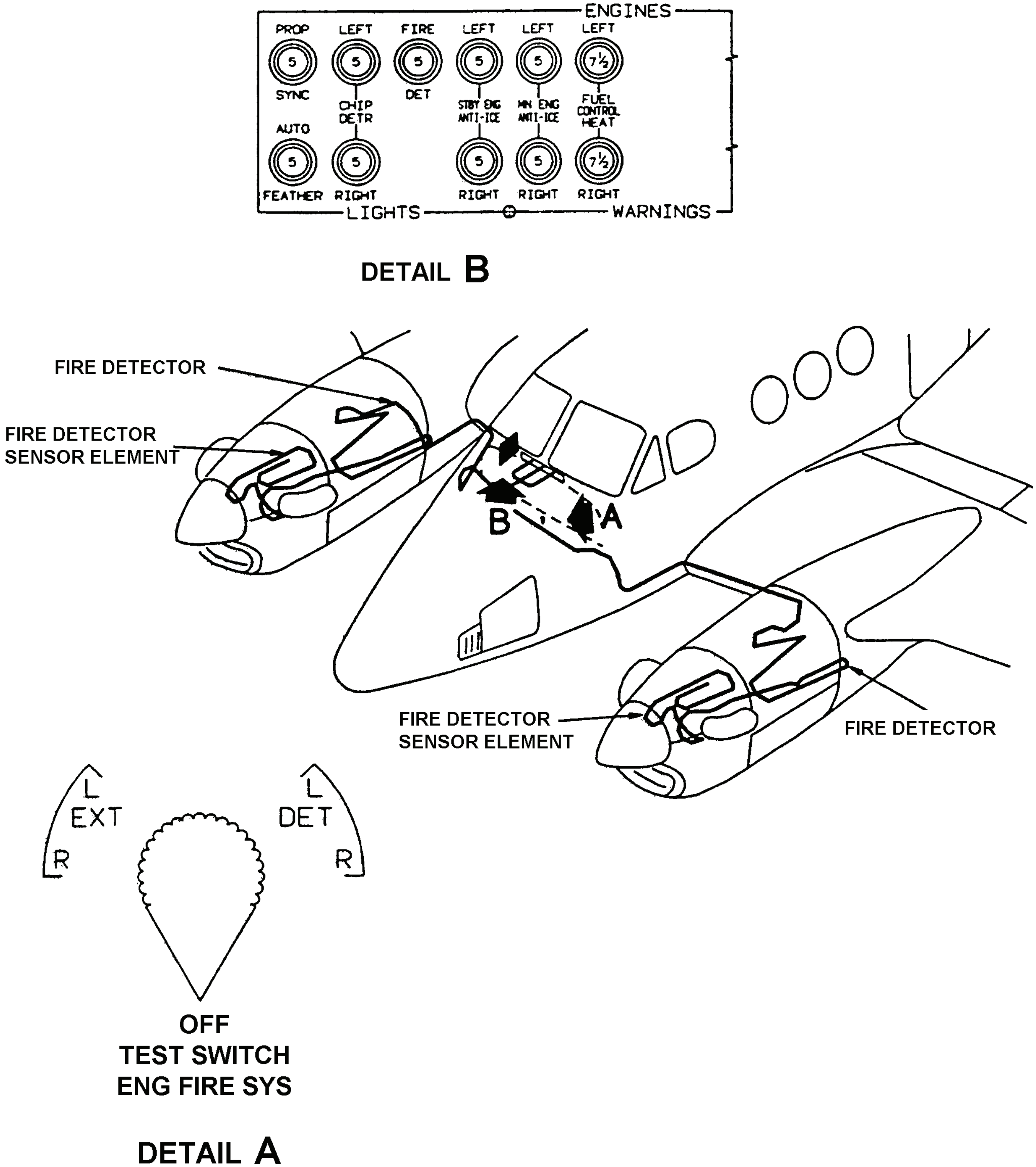


Figure 2-12. Engine Fire Detection System **R**

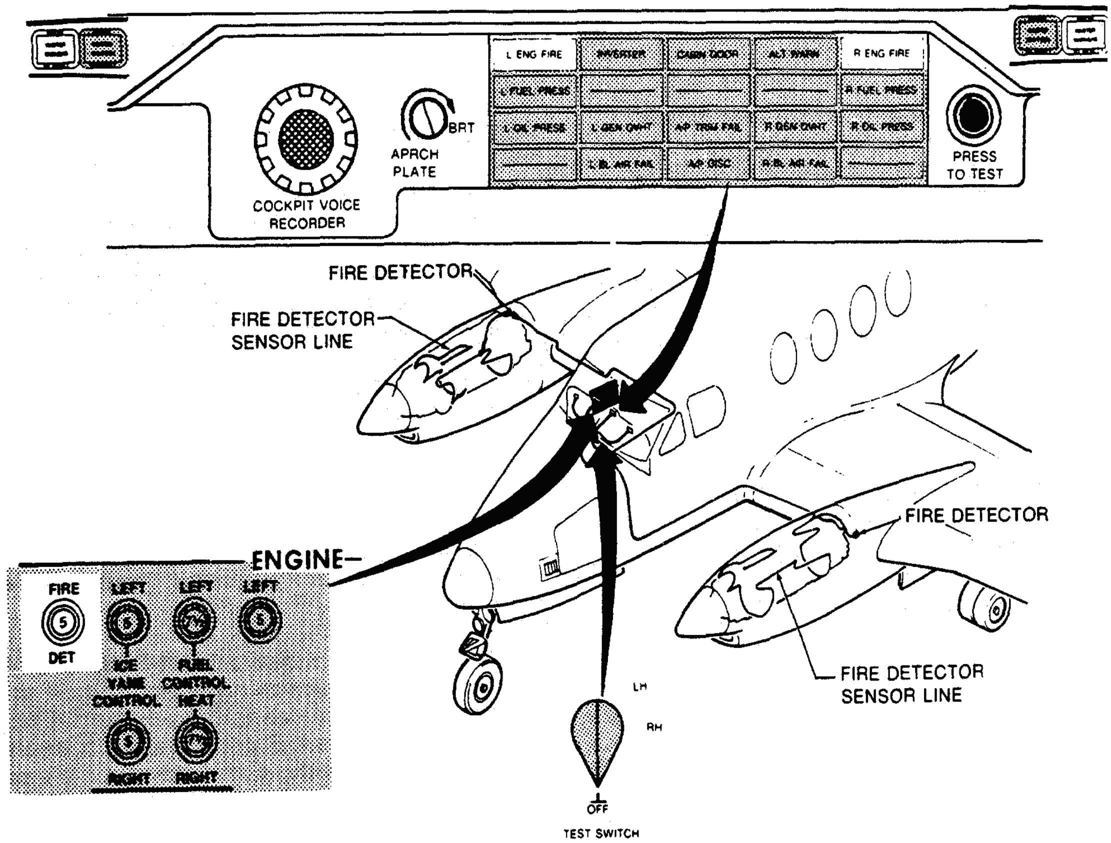


Figure 2-13. Engine Fire Detection System **T3 F3 OSA**

Testing system integrity, availability of power, and the alarm lights, (**L** and **R ENG FIRE** and **MASTER WARNING**) is accomplished by a single rotary switch located on the copilot's left subpanel. The switch, placarded **TEST SWITCH FIRE DET OFF / RH / LH**. **OFF** is at the six o'clock position, **RH** at the three o'clock and **LH** at the one-thirty position. At both the **RH** and **LH** positions, electrical current flows from a 5 amp circuit breaker placarded **FIRE DET** located on the right side circuit breaker panel, through the engine fire detector circuitry to the integrity switch contacts in the respective responder unit, causing the alarm lights to illuminate, thereby assuring the crew that the detector is operational. If the circuit breaker opens, the system will not operate during test, or activate the annunciator lights if the detector cable senses an over-temperature condition. The system may be tested either pre/post flight, or in flight as desired.

c. Description T3 F3 ANG. The ANG fire detection system, Figure 2-14, consists of three photoconductive cells for each engine; a control amplifier for each engine; two red warning lights on the warning annunciator panel, **L ENG FIRE** and **R ENG FIRE**; a test switch on the copilot's left subpanel; and a circuit breaker placarded **FIRE DET** on the right side panel. The six photoconductive cell flame detectors are sensitive to infrared radiation. They are positioned in each engine compartment so as to receive both direct and reflected rays, thus monitoring the entire compartment with three photocells.

Conductivity through the photocell varies in direct proportion to the intensity of the infrared radiation striking the cell. As conductivity increases, the amount of current from the electrical system flowing through the flame detector increases proportionally. To prevent stray light rays from signaling a false alarm, a relay in the control amplifier closes only when the signal strength reaches a preset alarm level. When the relay closes, the appropriate left or right warning annunciators illuminate. When the fire has been extinguished, the cell output voltage drops below the alarm level and the relay in the control amplifier opens. No manual resetting is required to reactivate the fire detection system.

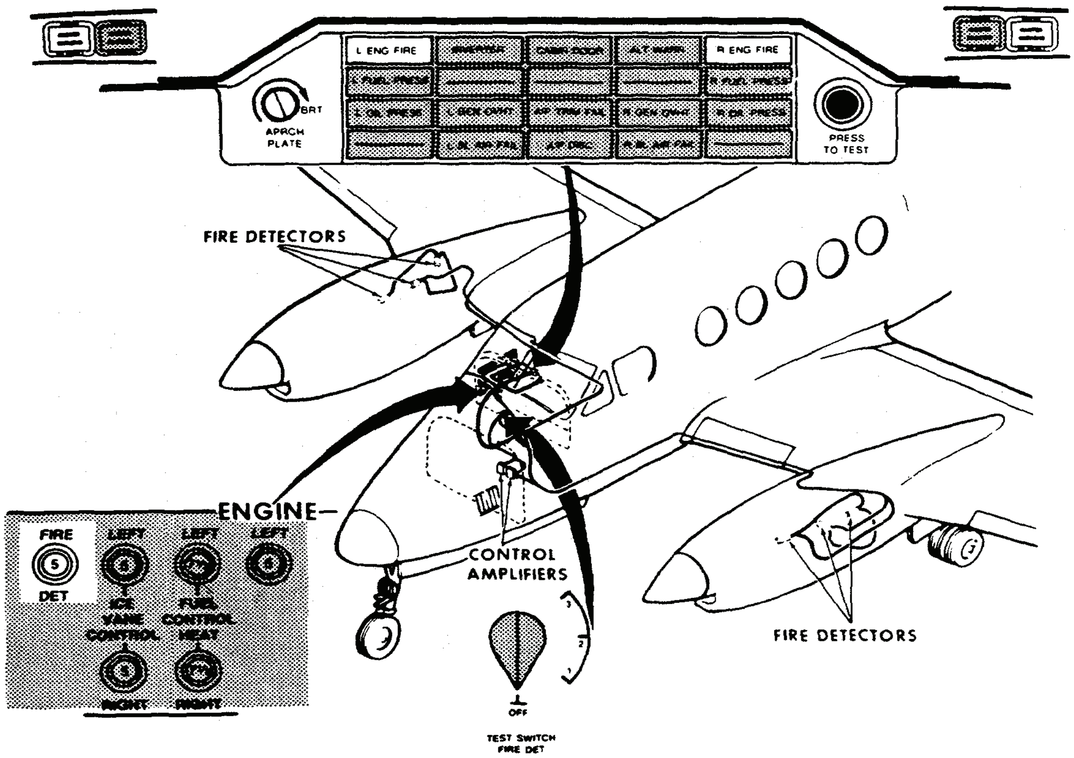


Figure 2-14. Engine Fire Detection System **T3 F3 ANG**

The test switch is on the copilot's left subpanel, and is placarded **TEST SWITCH FIRE DET OFF / 1 / 2 / 3**. The three test positions for the fire detector system are located on the right side of the switch (**1 / 2 / 3**). When the switch is rotated from **OFF** (down) to any one of these three positions, the output voltage of a corresponding flame detector in each engine compartment is increased to a level sufficient to signal the amplifier that a fire is present. The following should illuminate: the flashing red pilot and copilot **MASTER WARNING** lights, and the red warning annunciator panel lenses placarded **L ENG FIRE** and **R ENG FIRE**. The system may be tested either on the ground or in flight. The **TEST SWITCH** should be placed in all three positions, in order to verify that the circuitry for all six fire detectors is functional. Failure of all the fire detection system annunciators to illuminate when the **TEST SWITCH** is in any one of the three fire detector test positions indicates a malfunction in one or both of the two detector circuits (one in each engine) being tested by that particular position of the **TEST SWITCH**.

2-25. ENGINE FIRE EXTINGUISHER SYSTEM R.

NOTE

There is no fire extinguisher system on the C-12 T3 / F3 model aircraft.

a. Description. The engine fire extinguisher system consists of a supply cylinder, an explosive squib, and a valve located in each of the main gear wheel wells. Refer to Figure 2-15. A gauge calibrated in psi is provided on each supply cylinder for determining the level of charge. The extinguishing agent charge level should be checked during each preflight. When fired, the explosive squib opens the valve, releasing all of the pressurized extinguishing agent into a plumbing network. The plumbing network terminates in spray nozzles, strategically located in the probable fire areas of the engine compartment, which distribute the extinguishing agent.

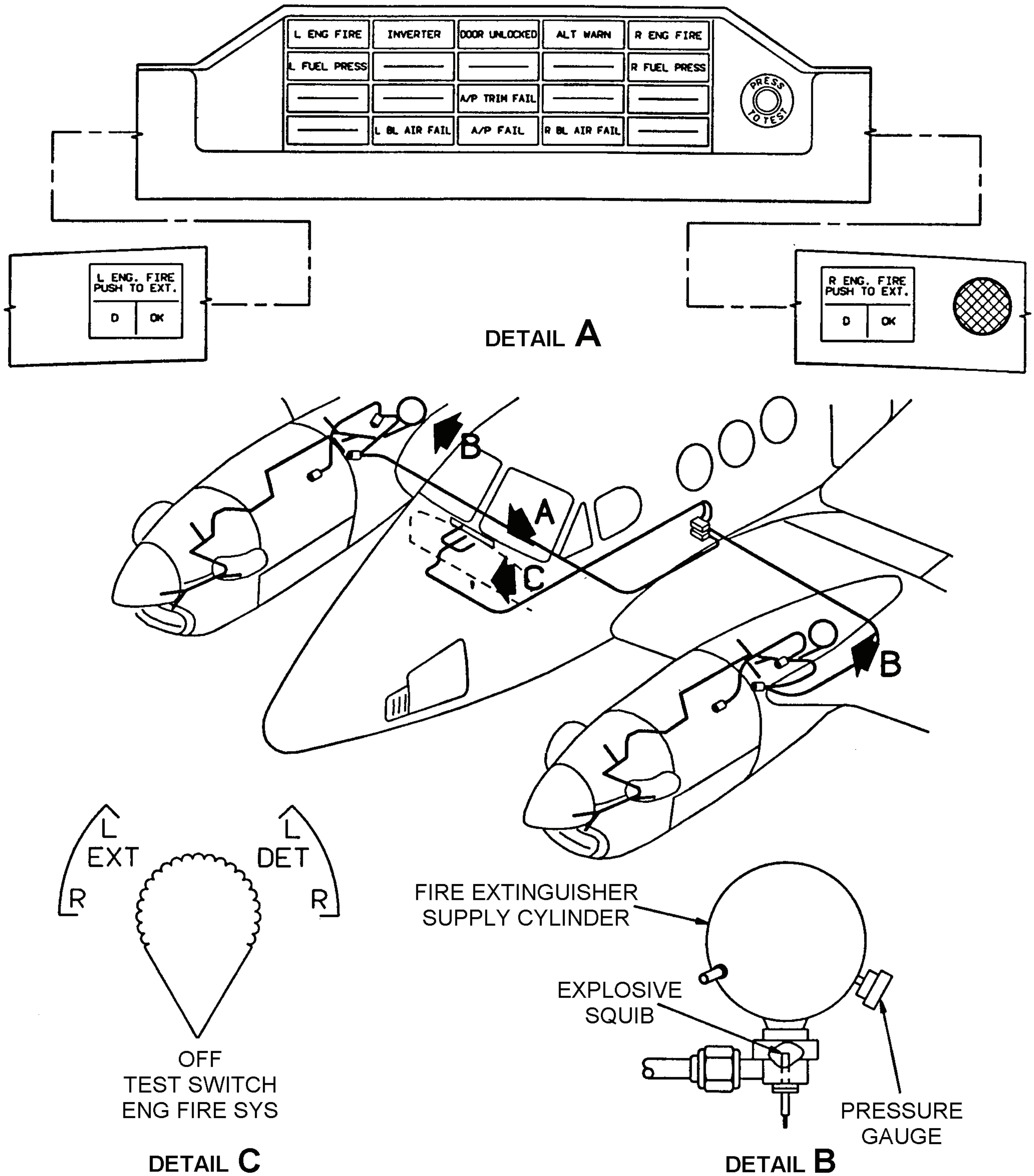


Figure 2-15. Engine Fire Extinguisher System R

b. Operation. The fire extinguisher control switch-indicators, which are used to discharge the extinguisher system, are located on the glareshield at each end of the warning annunciator panel. Each push to activate switch-indicator consists of three annunciators. A red annunciator placarded **D**, indicates that the system has been discharged, a green annunciator, placarded **OK**, is provided for system test. To discharge the extinguisher, raise the safety wired clear plastic cover and press the **ENG FIRE PUSH TO EXT** switch-indicator. These controls receive power from the hot battery bus. The fire extinguisher will be completely expended upon activation. The yellow **D** annunciator will illuminate and remain illuminated, regardless of battery switch position until the pyrotechnic cartridge has been replaced.

c. Fire Extinguisher TEST SWITCH. The fire extinguisher system test switch is used to test the circuit integrity of the fire extinguishing system. During preflight, the pilot should rotate the **TEST SWITCH** to the **EXT R** and **EXT L** positions and verify the illumination of the yellow **D** annunciator and the green **OK** annunciator on each fire extinguisher activation switch on the glareshield.

d. Fire Extinguisher Pressure Gauge. A gauge, calibrated in psi, is provided on each fire extinguisher supply cylinder for determining the level of charge. The gauges should be checked during preflight. Refer to Table 2-1 for appropriate pressure.

2-26. OIL SUPPLY SYSTEM.

CAUTION

Maximum allowable oil consumption is 1 quart in 5 hours of engine operation.

a. Engine Oil Tank. The engine oil tank is integral with the air-inlet casting located forward of the accessory gearbox. An external line from the high-pressure pump supplies oil for propeller operation and lubrication of the reduction gearbox and engine bearings. Two scavenge lines return oil to the tank from the propeller reduction gearbox. A non-congealing, external oil cooler keeps the engine oil temperature within operating limits. The capacity of each engine oil tank is 2.5 U.S. gallons. The total system capacity for each engine, which includes the oil tank, oil cooler, lines, etc., is approximately 3.5 U.S. gallons. A dipstick attached to the oil filler cap indicates the oil level. Oil grade, specifications, and servicing points are described in Section XII, Servicing, Parking, and Mooring.

b. Engine Oil System. The oil system of each engine is coupled to an oil cooler unit (radiator) of fin-and-tube design. The oil cooler unit, located in the lower aft nacelle below the engine air intake, is the only airframe-mounted pan of the oil system. Each oil cooler incorporates a thermal bypass valve that assists in maintaining oil at the proper temperature range for engine operation.

2-27. ENGINE IGNITION SYSTEM.

a. Description. The basic ignition system for each engine consists of a solid-state ignition exciter unit, two igniter plugs, two shielded ignition cables, pilot controlled **IGNITION AND ENGINE START** switches, and the **ENG AUTO IGNITION** switches. Placing either **ENGINE START** switch to the **ON** position will cause the respective engine to motor and igniter plugs to spark, igniting the fuel/air mixture sprayed into the combustion chamber by the fuel nozzles. The ignition system is activated for ground and air starts, but is switched off after combustion light up.

b. Ignition and Engine Start Switches. Two three-position toggle switches, placarded **IGNITION AND ENGINE START LEFT / RIGHT ON / OFF STARTER ONLY**, are located on the pilot's subpanel. These switches will initiate starter motoring and ignition in the **ON** position, or will motor the engine in the **STARTER ONLY** position. The **ON** switch position completes the starter circuit for engine rotation, energizes the igniter plugs for fuel combustion, and activates the respective **L IGNITION ON** or **R IGNITION ON** annunciator on the caution/advisory annunciator panel. The center switch position is **OFF**. Two 5-ampere circuit breakers on the left sidewall circuit breaker panel, Figure 2-16, placarded **LEFT** and **RIGHT IGNITOR POWER**, protect the ignition circuits. Two 5-ampere circuit breakers on the left sidewall circuit breaker panel, placarded **LEFT** and **RIGHT START CONTROL**, protect the starter control circuits.

Table 2-1. Engine Fire Extinguisher Gauge Pressure

TEMP °C	-40	-29	-18	-06	04	16	27	38	48
PSI	190 to 240	220 to 275	250 to 315	290 to 365	340 to 420	390 to 480	455 to 550	525 to 635	605 to 730

2-28. AUTO IGNITION SYSTEM.

If armed, the auto ignition system automatically energizes both igniter plugs of either engine, should an accidental flameout occur. The system is not essential to normal engine operation, but is used to reduce the possibility of power loss due to icing or other conditions. Each engine has a separate **ENG AUTO IGNITION** control switch and a green annunciator, **LEFT/L IGNITION ON** and **RIGHT/R IGNITION ON**, located on the caution/advisory annunciator panel. Auto ignition is accomplished by energizing both igniter plugs in each engine.

NOTE

The system should be turned OFF during extended ground operation to prolong the life of the igniter plugs.

a. Auto Ignition Switches. Two switches located on the pilot's subpanel, each placarded **ENG AUTO IGNITION ARM / OFF LEFT / RIGHT**, control the auto ignition systems. The **ARM** position initiates a readiness mode for the auto ignition system of the corresponding engine. The system is disarmed when in the **OFF** position. The corresponding 5-ampere **LEFT** or **RIGHT IGNITOR POWER** circuit breaker on the left sidewall circuit breaker panel protects each circuit. Refer to Figure 2-16.

b. Auto Ignition Annunciators. If an armed auto ignition system changes from a ready condition to an operating condition (energizing the igniter plugs in the engine) the corresponding engine's green **L** or **R IGNITION ON** annunciator will illuminate, indicating that the igniters are energized. The auto ignition system is triggered from a ready condition to an operating condition when engine torque drops below approximately 20%. Therefore, when an auto ignition system is armed, the igniters will be energized continuously during the time when an engine is operating at a level below approximately 20% torque.

2-29. ENGINE STARTER-GENERATORS.

One starter-generator is mounted on the accessory drive section of each engine. Each starter-generator is able to function either as a starter or as a generator. In the starter function, 24 Vdc is required to power rotation. In the generator function, each unit is capable of 250 amperes dc output. When the starting function is selected, the starter control circuit receives power from either the aircraft battery or an external power source through the respective 5-ampere **LEFT** or **RIGHT START CONTRO**L circuit breaker, located on the left sidewall circuit breaker panel. When the generating function is selected, the starter-generator provides electrical power.

2-30. ENGINE INSTRUMENTS.

The engine instruments are arranged vertically near the center of the instrument panel. Refer to Figure 2-17, Sheets 1 through 8. The circuit breakers for all engine instruments are located on the left sidewall circuit breaker panel. All engine instrument circuit breakers are fed through the 7 1/2-ampere **LEFT** and **RIGHT ENG INSTR POWER** circuit breakers located on the right sidewall circuit breaker panel.

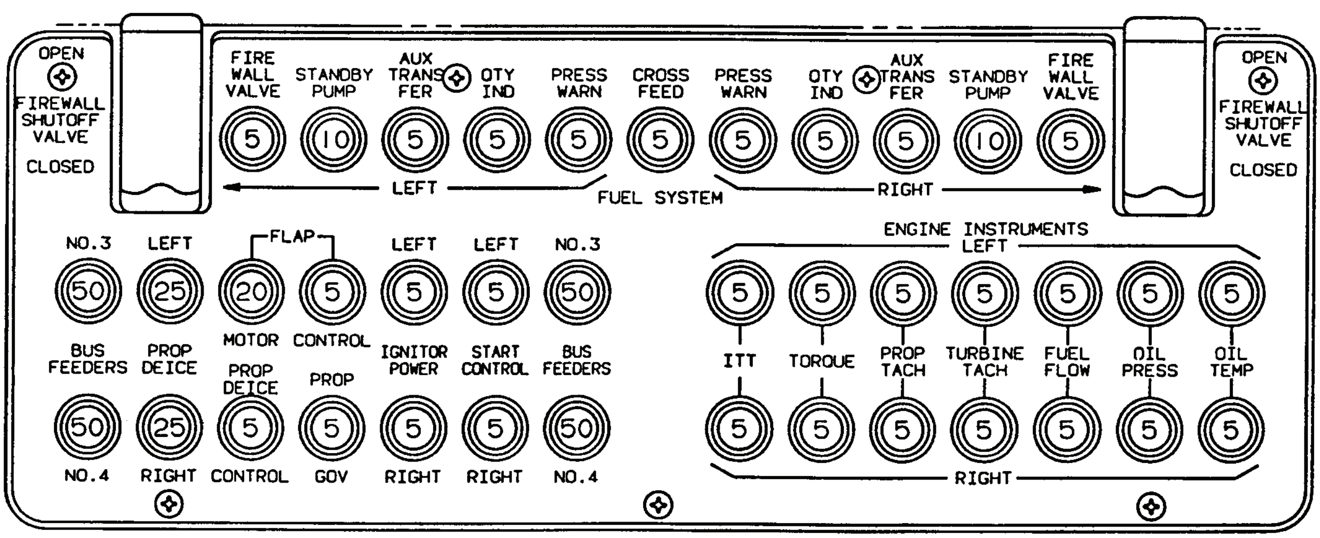
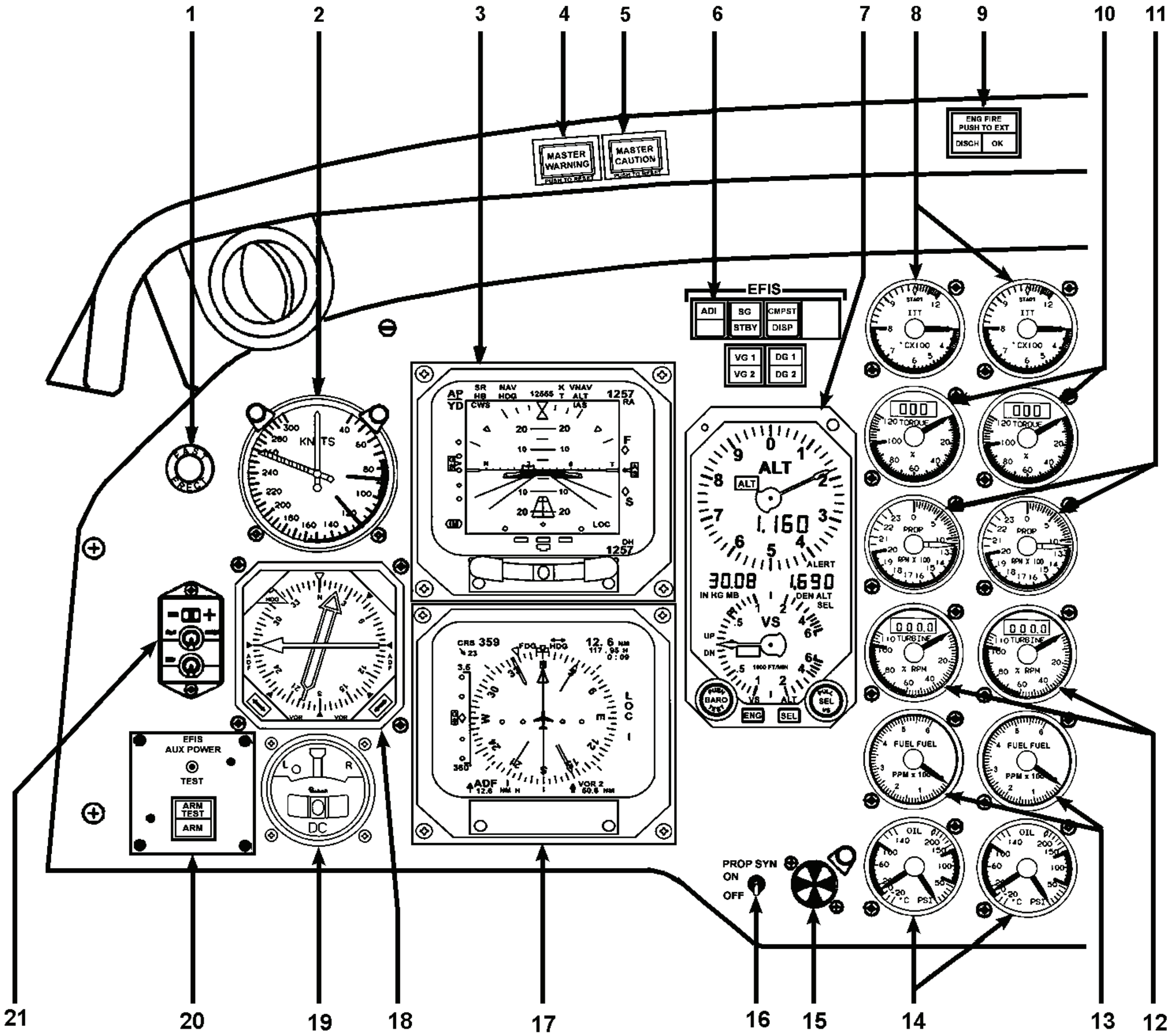
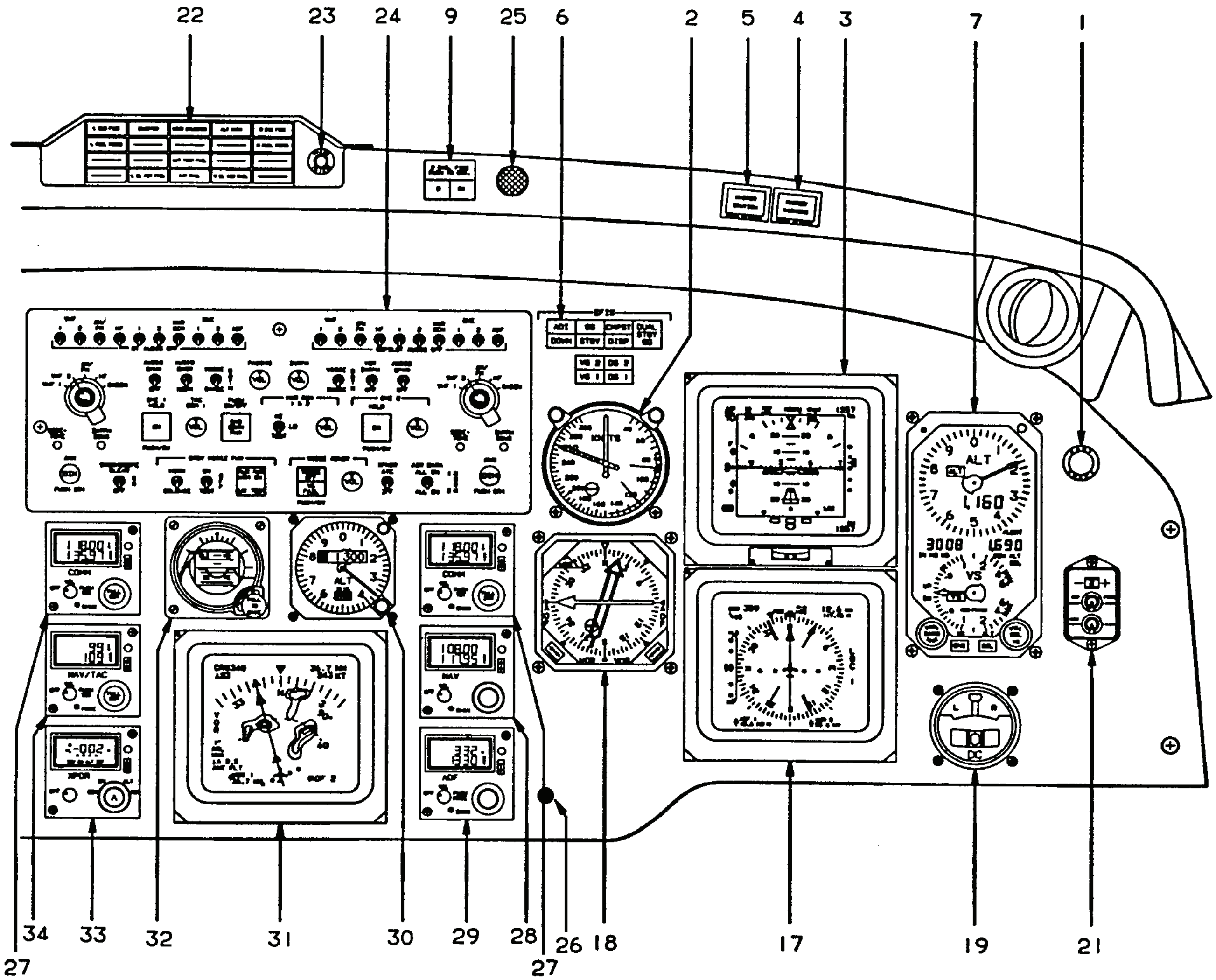


Figure 2-16. Left Sidewall Circuit Breaker Panel



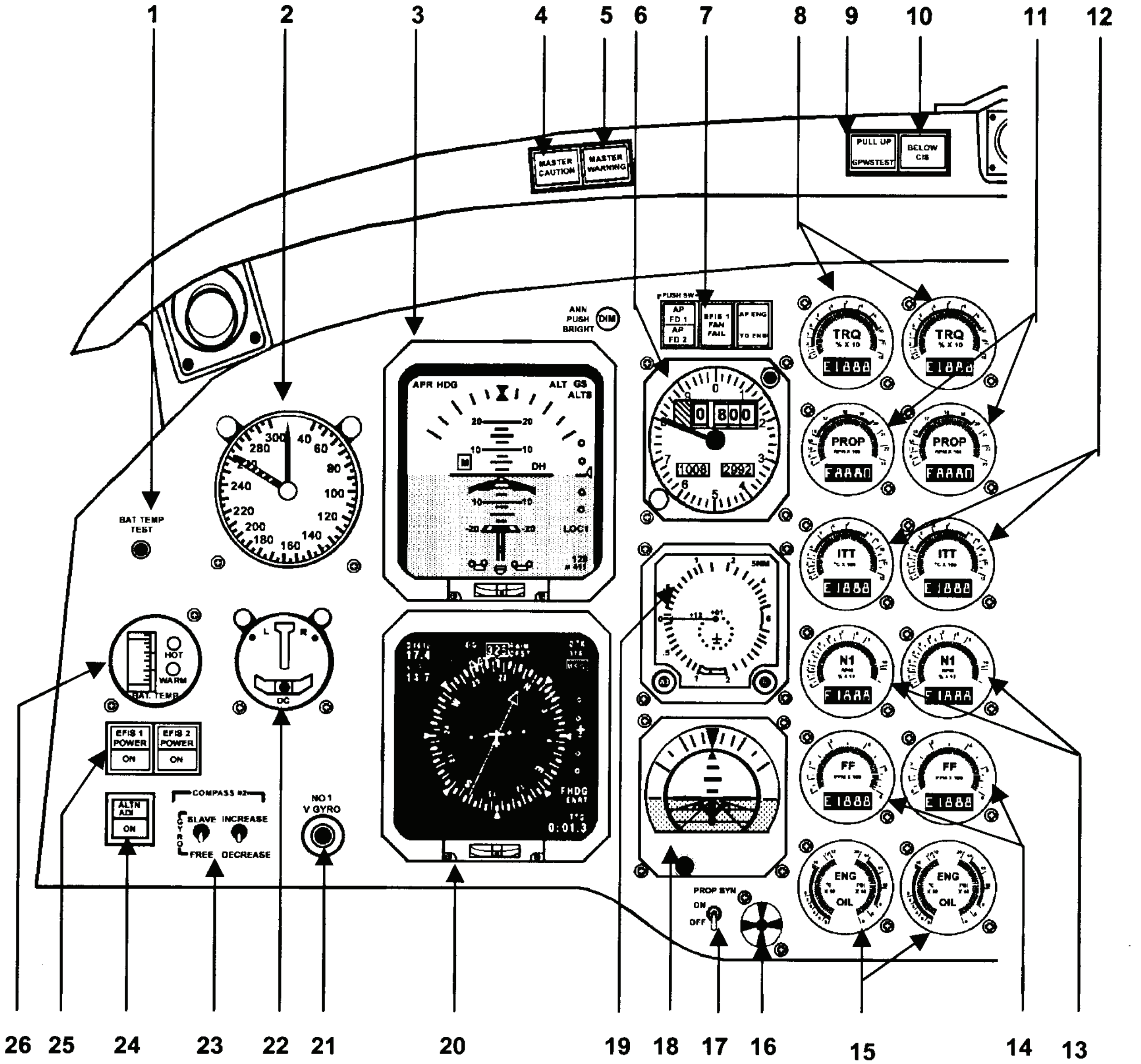
1. Vertical Gyro FAST ERECT Switch
2. Airspeed Indicator
3. Electronic Attitude Director Indicator (EADI)
4. MASTER WARNING Switch-Indicator
5. MASTER CAUTION Switch-Indicator
6. EFIS Switch-Indicators
7. Altitude / Vertical Speed Indicator / Control
8. Interstage Turbine Temperature Gauges
9. Engine Fire Detection / Extinguisher Switch-Indicators
10. Torquemeters
11. Propeller Tachometers
12. Turbine Tachometers
13. Fuel Flowmeters
14. Oil Temperature / Pressure Gauges
15. Propeller Synchroscope
16. Propeller Synchrophaser Control Switch
17. Electronic Horizontal Situation Indicator (EHSI)
18. Radio Magnetic Indicator
19. Turn and Slip Indicator
20. EFIS Auxiliary Power Control Panel
21. Compass Slaving Control Panel

*Figure 2-17. Instrument Panel **R** (Sheet 1 of 8)*



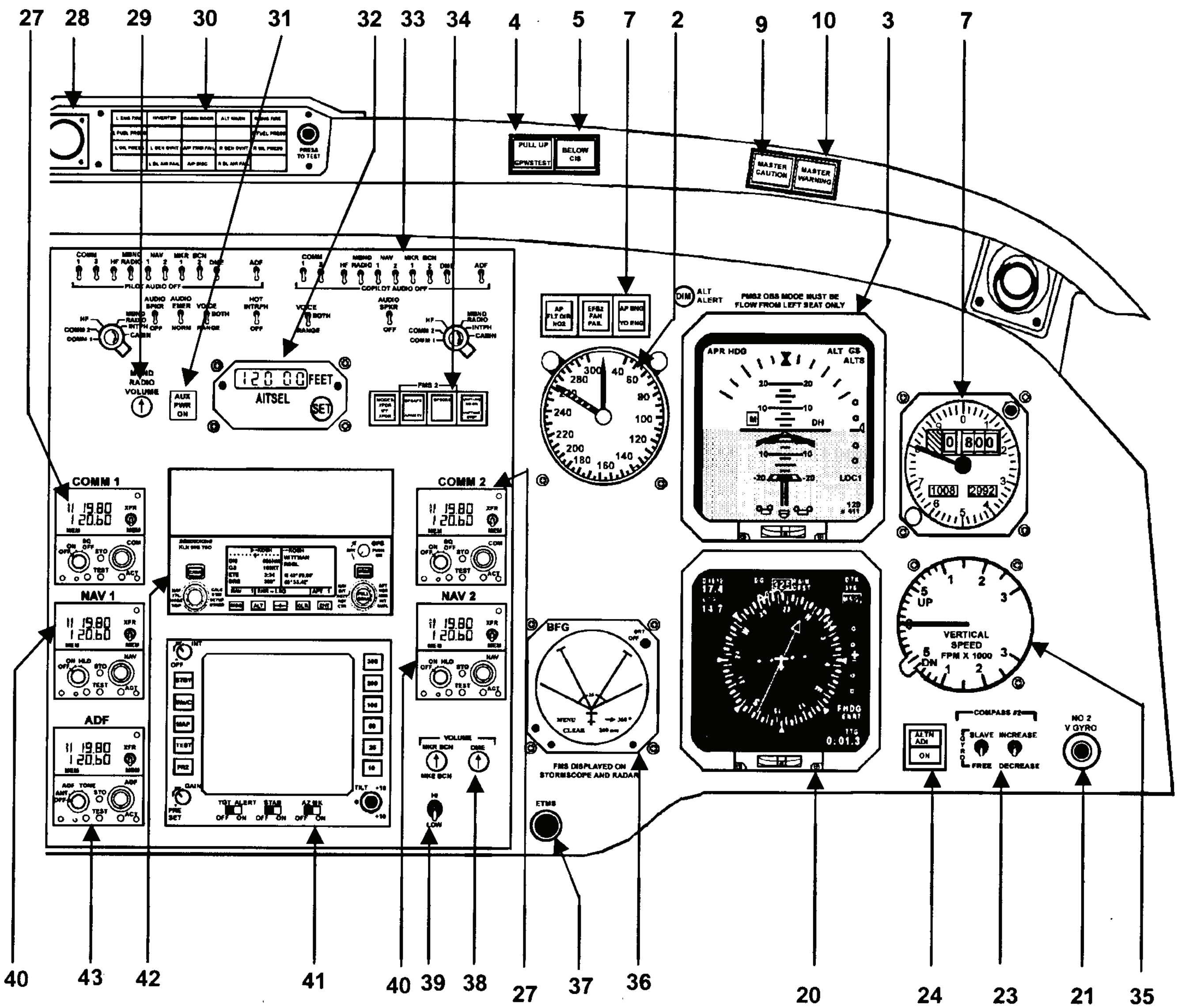
22. Warning Annunciator Panel
23. Annunciator Test Switch
24. Audio Control Panel
25. Cockpit Voice Recorder Microphone
26. Engine Trend Monitor System
27. Communications Transceiver Control Unit
28. Navigation Receiver Control Unit
29. ADF Receiver Control Unit
30. Standby Altimeter
31. Multifunction Display
32. Standby Attitude Indicator
33. Transponder Control Panel
34. Navigation / TACAN Receiver Control Unit

Figure 2-17. Instrument Panel **R** *(Sheet 2 of 8)*



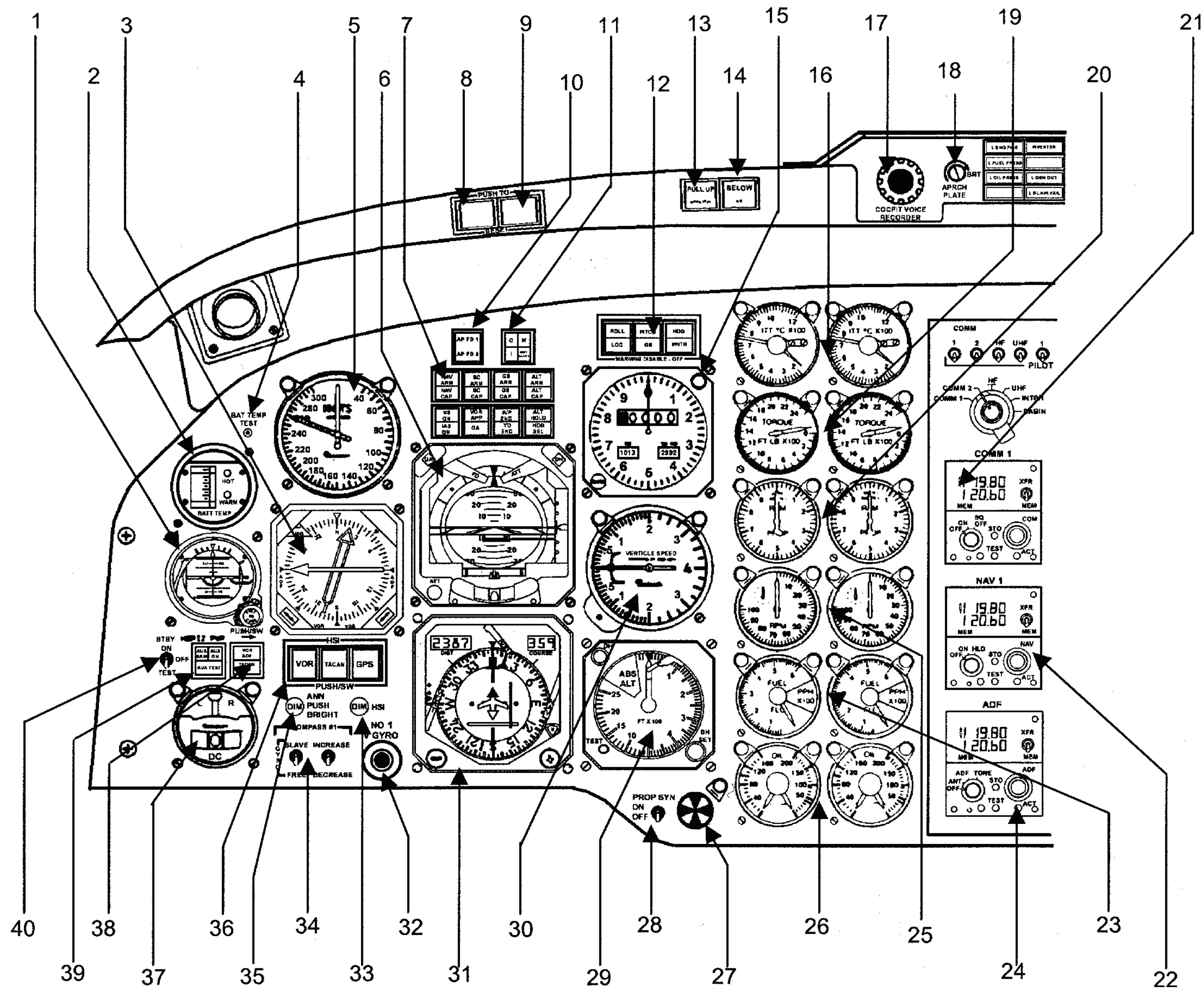
1. Battery Temperature Test Switch
2. Airspeed Indicator
3. Electronic Attitude Director Indicator
4. Master Caution Switch - Indicator
5. Master Warning Switch Indicator
6. Altimeter
7. AP / FD Annunciator Panel
8. Torquemeter
9. GCAS TEST and PULL UP Indicator/ Switch
10. GCAS GS Indicator
11. Propeller Tachometers
12. Interstage Turbine Temperature Gauges
13. Turbine Tachometers (N1)
14. Fuel Flowmeters
15. Oil Temperature / Pressure Gauges
16. Propeller Synchroscope
17. Propeller Synchrophaser Control Switch
18. Standby Attitude Indicator
19. VSI/TCAS Display
20. Electronic Horizontal Situation Indicator
21. Vertical Gyro Fast Erect Switch 1 and 2
22. Turn and Slip Indicator
23. Gyro COMPASS SLAVE / INCR / DECR Switches
24. Reversionary Switch
25. EFIS Power Switches
26. Battery Temperature Indicator

*Figure 2-17. Instrument Panel **T3** **OSA** **ANG** (Sheet 3 of 8)*



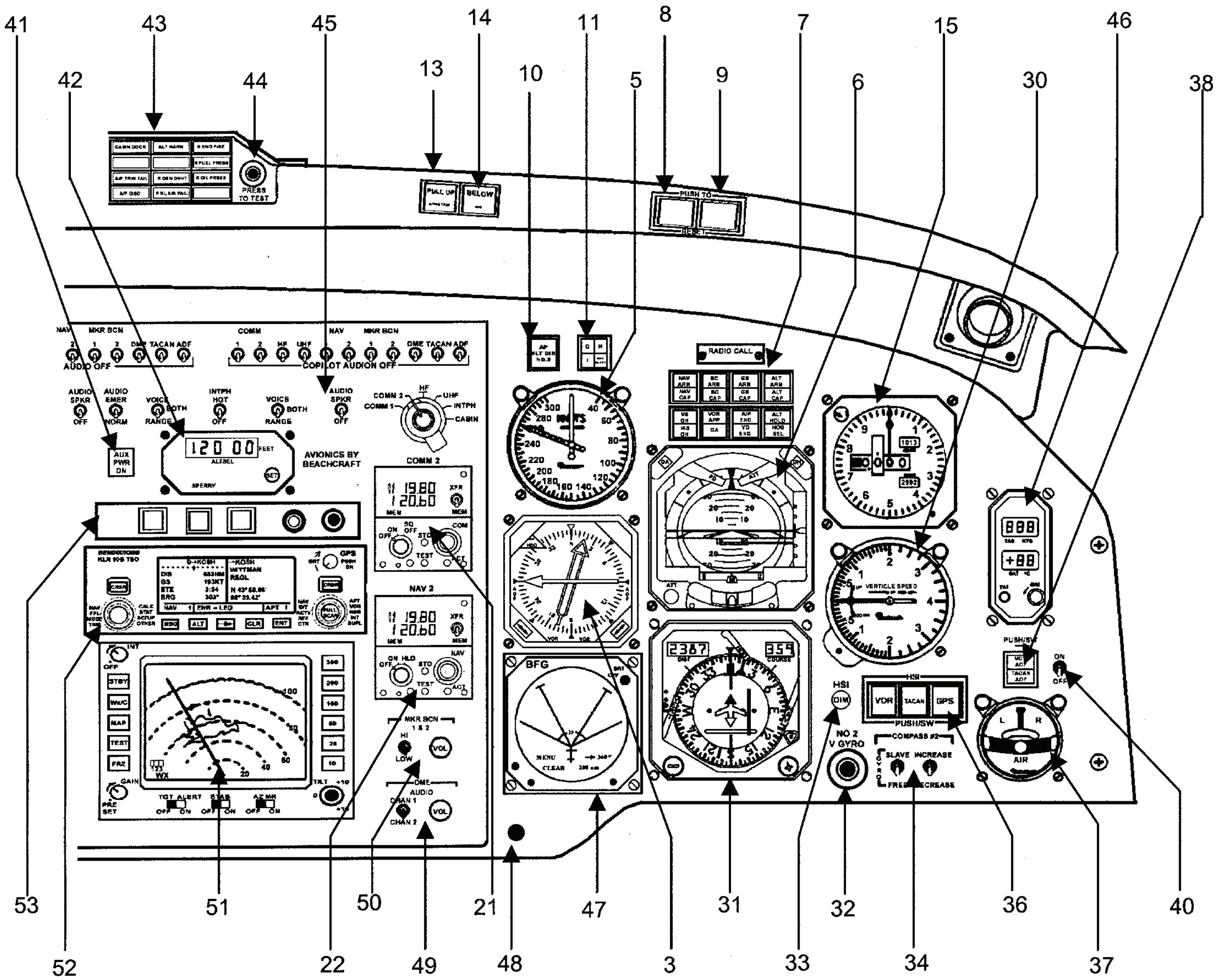
27. VHF Comm 1 and 2
28. Cockpit Voice Recorder OSA Only
29. ARC-210 Volume Control
30. Warning Annunciator Panel
31. Auxiliary Power Switch
32. Altitude Alert Display
33. Audio Control Panel
34. KLN 90B Annunciator Panel
35. Vertical Speed Indicator
36. Stormscope
37. Engine Trend Motoring System
38. DME Volume Control
39. Marker Beacon Volume and Sensing
40. Navigation Receiver Control Unit
41. Weather Radar
42. KLN-90B
43. ADF Receiver Control Unit

Figure 2-17. Instrument Panel T3 OSA ANG (Sheet 4 of 8)



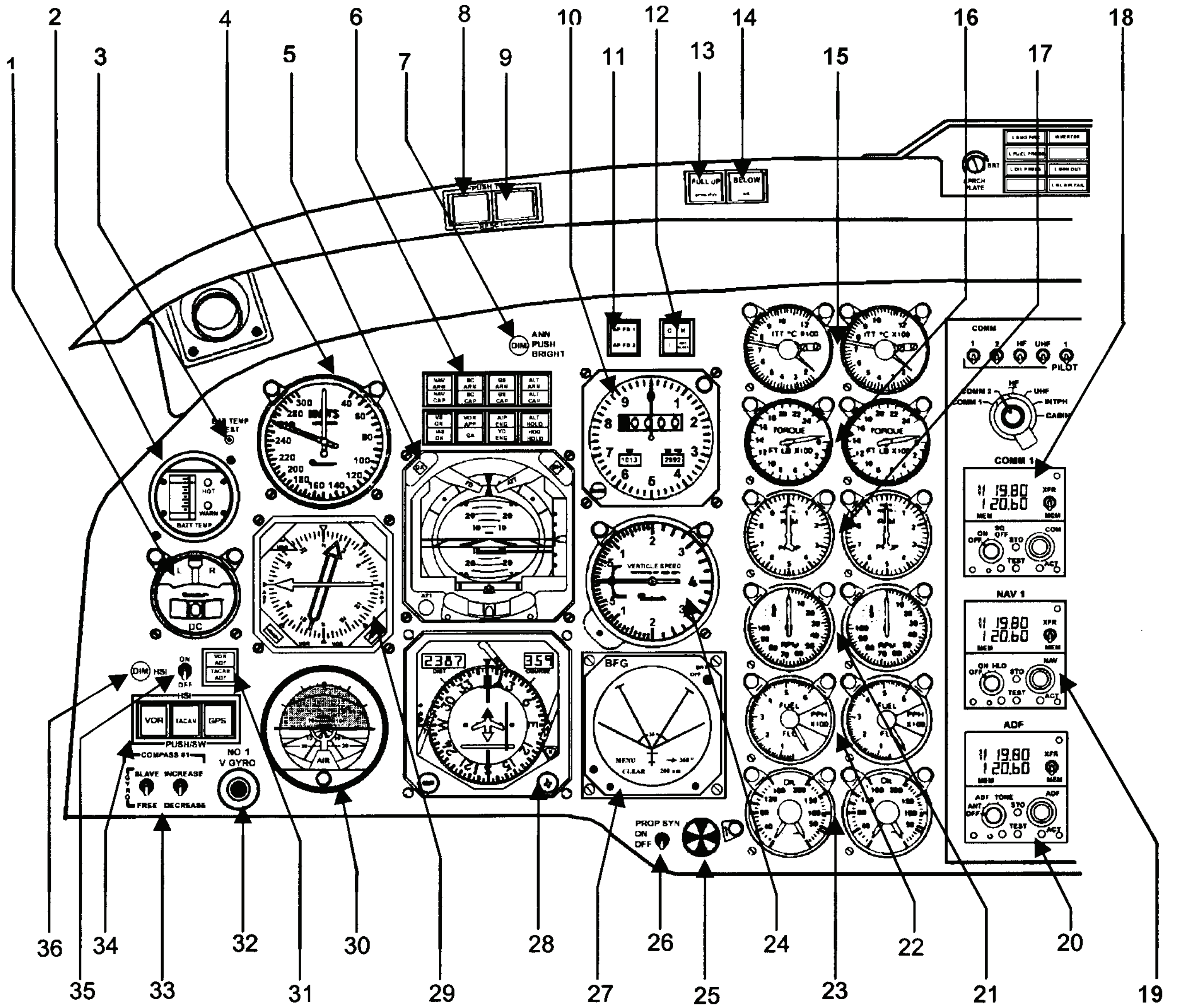
1. Standby Attitude Indicator
2. Battery Temperature Indicator
3. Radio Magnetic Indicator
4. Battery Temperature Test Switch
5. Airspeed Indicator
6. Attitude Direction Indicator
7. Flight Director/Mode Selector
8. Master Warning Switch / Indicator
9. Master Caution Switch / Indicator
10. AP FD 1 & 2 Annunciators
11. Marker Beacon/WPT Annunciator Panel
12. Comparator Annunciator Panel
13. GCAS PULL UP/Test Switch
14. GCAS Below GS Indicator
15. Altimeter
16. Interstage Turbine Temperature Gauges
17. Cockpit Voice Recorder
18. Approach Plate Bright Switch (O)
19. Torquemeters
20. Propeller Tachometers
21. VHF Comm Radio
22. VHF Nav Radio
23. Fuel Flowmeters
24. Automatic Direction Finder (ADF) Controller
25. Turbine Tachometer N_1
26. Oil Temperature/Pressure Gauges
27. Propeller Synchroscope
28. Propeller Synchrophaser Control Switch
29. Radio Altimeter Indicator
30. Vertical Speed Indicator
31. Horizontal Situation Indicator (HSI)
32. No 1 Vert Gyro Fast Erect Switch
33. HSI Dim Switch
34. No. 1 Compass Gyro Free / Slave Increase / Decrease Switch
35. Annunciator Bright / Dim Switch
36. HSI Source Selector Switches
37. Turn and Slip Indicator
38. RMI Needle Selection Switch
39. Standby Attitude Reference Annunciator Panel
40. Standby Attitude Reference Power Switch

Figure 2-17. Instrument Panel F3 OSA (Sheet 5 of 8)



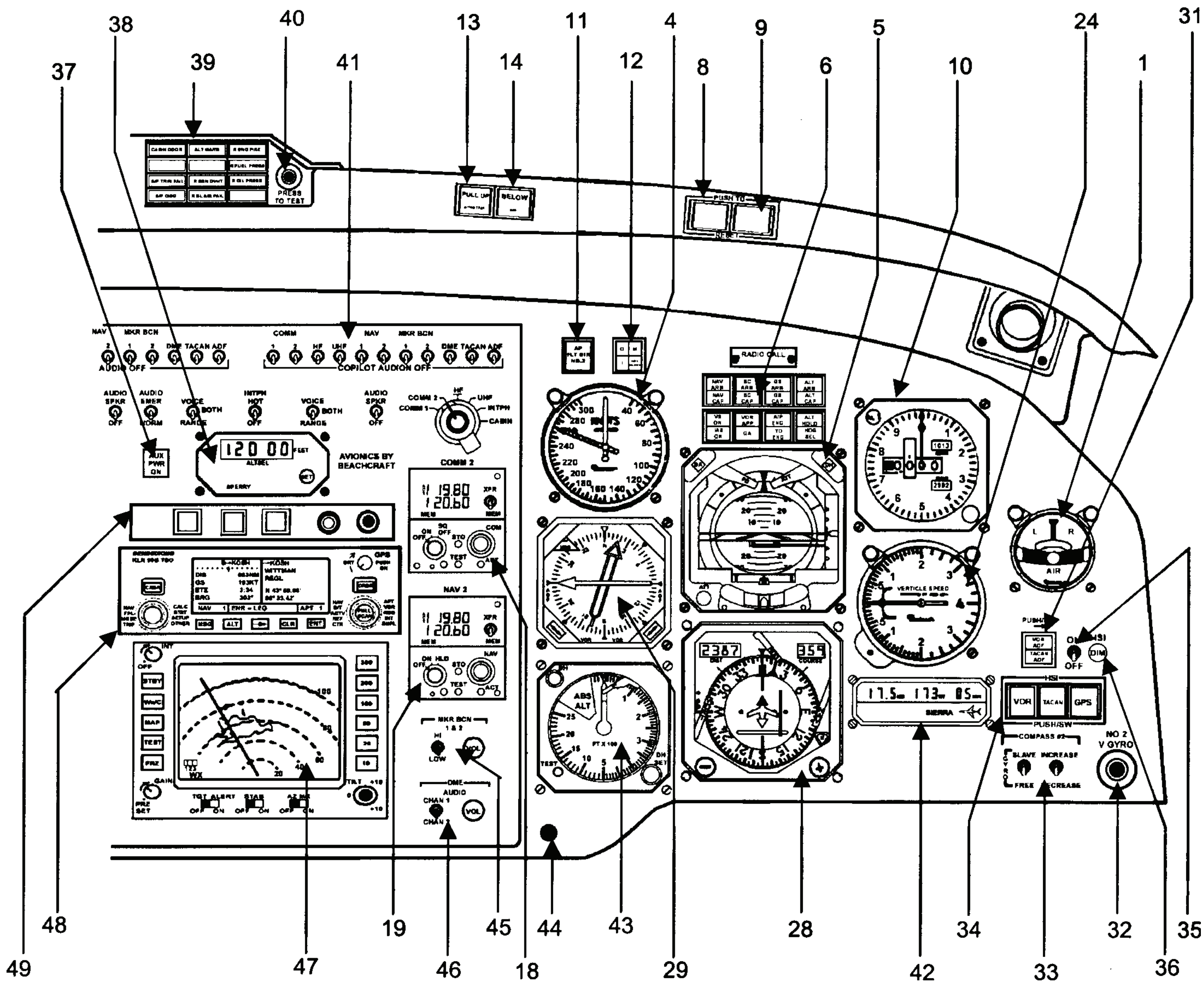
41. Auxiliary Power Annunciator
42. Altitude Select Controller
43. Warning Annunciator Panel
44. Warning Annunciator Panel Test Switch
45. Audio Control Panel
46. TAS / SAT / TAT Indicator
47. Stormscope
48. Engine Trend Monitor System
49. DME Channel Select Switch / Volume
50. Marker Beacon Hi-Low Sensor / Volume Switches
51. Weather Radar
52. KLN-90B (GPS)
53. KLN-90B External Annunciator Panel

Figure 2-17. Instrument Panel F3 OSA (Sheet 6 of 8)



1. Turn and Slip Indicator
2. Battery Temperature Indicator
3. Battery Temperature Test Switch
4. Airspeed Indicator
5. Attitude Direction Indicator
6. Flight Director/Mode Selector
7. Annunciator Dim Switch
8. Master Warning Switch / Indicator
9. Master Caution Switch / Indicator
10. Altimeter
11. AP FD 1 & 2 Annunciators
12. Marker Beacon
13. GCAS PULL UP/Test Switch
14. GCAS Below GS Indicator
15. Interstage Turbine Temperature Gauges
16. Torquemeters
17. Propeller Tachometers
18. VHF Comm Radio
19. VHF Nav Radio
20. Automatic Direction Finding (ADF) Control
21. Turbine Tachometers (N_1)
22. Fuel Flowmeters
23. Oil Temperature/Pressure Gauges
24. Vertical Speed Indicator
25. Propeller Synchroscope
26. Propeller Synchrophaser Control Switch
27. Stormscope
28. Horizontal Situation Indicator
29. Radio Magnetic Indicator (RMI)
30. Standby Attitude Reference Indicator
31. Needle Selector Switch
32. No. 1 Vert Gyro Fast Erect Switch
33. No. 1 Compass Gyro Free / Slave Increase / Decrease Switch
34. HSI Source Selector Switches
35. On / Off Switch
36. HSI Dim Switch

Figure 2-17. Instrument Panel **F3** **ANG** *(Sheet 7 of 8)*



37. Auxiliary Power Switch
38. Altitude Select Controller
39. Warning Annunciator Panel
40. Warning Panel Test Switch
41. Audio Control Panel
42. TACAN Indicator
43. Radio Altimeter Indicator
44. Engine Trend Monitoring System
45. Marker Beacon Hi-Low Sensor Switch / Volume
46. DME Channel Select Switch / Volume
47. Weather Radar
48. KLN-90B GPS
49. GPS External Annunciators

Figure 2-17. Instrument Panel **F3** **ANG** *(Sheet 8 of 8)*

a. **Engine Instruments R .**

(1) Interstage Turbine Temperature (ITT) Indicators. The two ITT gauges on the instrument panel are calibrated in degrees Celsius (°C). Each gauge is connected to thermocouple probes located in the hot gases between the turbine wheels. The gauges indicate the temperature between the compressor turbine and power turbine section for the corresponding engine. Individual 5-ampere circuit breakers, placarded **ITT LEFT / RIGHT**, located on the left sidewall circuit breaker panel, protect the interstage turbine temperature gauge circuits.

(2) Engine Torquemeters. Two torquemeters on the instrument panel indicate torque in percent of maximum being applied to the propeller shaft of the respective engine. Individual 5-ampere circuit breakers, placarded **TORQUE LEFT / RIGHT** located on the left sidewall circuit breaker panel, protect the torquemeter's circuits.

(3) Turbine Tachometers. Two tachometers on the instrument panel indicate compressor turbine RPM (N_1) for the respective engine as a percentage of maximum gas generator RPM. Each instrument is slaved to a tachometer generator attached to the respective engine. Individual 5-ampere circuit breakers, placarded **TURBINE TACH LEFT / RIGHT,** located on the left sidewall circuit breaker panel, protect the turbine tachometer circuits.

(4) Fuel Flow Indicators. Two gauges on the instrument panel indicate the race of flow for consumed fuel as measured by sensing units coupled into the fuel supply lines of the respective engines. The fuel flow indicators are calibrated in increments of hundreds of pounds per hour. Individual 5-ampere circuit breakers, placarded **FUEL FLOW LEFT / RIGHT** located on the left sidewall circuit breaker panel, protect fuel flow indicator circuits.

(5) Oil Pressure / Oil Temperature Indicators. Two gauges on the instrument panel indicate oil pressure in psi and oil temperature in °C. Oil pressure is taken from the delivery side of the main oil pressure pump. A thermal sensor unit that senses the temperature of the oil as it leaves the delivery side of the oil pressure pump transmits oil temperature. Each gauge is connected to pressure and temperature transmitters installed on the respective engine. Individual 5-ampere circuit breakers, placarded **OIL PRESS LEFT / RIGHT**, located on the left sidewall circuit breaker panel protect the oil pressure circuits. Individual 5-ampere circuit breakers, placarded **OIL TEMP LEFT / RIGHT**, located on the left sidewall circuit breaker panel, protect the oil temperature circuits.

b. **Engine Instruments T3 .**

(1) Two ITT gauges on the instrument panel are calibrated in °C. Each gauge is connected to thermocouple probes located in the hot gases between the turbine wheels. The gauges register the temperature present between the compressor turbine and power turbine for the corresponding engine. The indicator display is a 1 alphabetic, 3 1/2 numeric character digital display and a 41 segment bar graph display. The bar graph display is nonlinear. The indicator has a display range of 0 to 1200 °C while displaying current ITT and 0 to 1372 °C while displaying exceedence ITT. The bar graph display ranges from 0 to 1200 °Celsius. The display will contain dashes (-----) when the measured ITT is greater than 1200 °Celsius. When the EXCEEDENCE ITT value is displayed the actual measured value, not the dashes, will be displayed up to 1372 °Celsius.

The indicator is equipped with a Built-In Test (BIT) display that will display all active LCD segments for 3 seconds on power up. If the BIT test detects a failed ROM or RAM, the BIT indicator will have a blank display. If the BIT failure is the input signal, a 0 will be displayed on both the digital and bar graph displays. If the failed BIT is caused by the EEPROM, an F will prefix the display. BIT failures will not be stored in EEPROM. Once power is reapplied the previous failures detected will not affect the display.

When a limit is exceeded, an exceedence event will be stored in the EEPROM memory. All event records will consist of two words. One word will contain the peak temperature measured during the event with a resolution of 1 °C. The other word will contain the event duration in seconds with a resolution of 1 second. A maximum of 50 events will be recorded. If more than 50 events are recorded, the new event will be recorded and the oldest event shall be discarded. The prefix **E** will be displayed when an event is being or has been recorded and not played back. The digital display will start flashing whenever a temperature limit has been exceeded. The flashing will cease and the display prefixed with an **E** when the time/temperature combination is exceeded and an exceedence is being recorded.

NOTE

Pressing the EXCEEDENCES ERASE switch for 0.2 seconds or longer will cause all events to be erased from non-volatile memory <u>in all engine instruments</u>. There is no provision for erasing individual events from individual system gauges.

The event display will take precedence over normal digital display. The bar graph will continue to display current ITT data. To activate the event display, hold the **EXCEEDENCE DISPLAY** switch for 0.2 seconds or longer. The events will be displayed in reverse chronological order (most recent event first). All event displays will consist of the following cycles:

1. A two-digit event number displayed for 2 seconds.

2. The event peak temperature values in °Celsius displayed for 2 seconds.

3. The event duration, in seconds, displayed for 2 seconds.

All three data items displayed during playback shall be prefixed with a **P** if the event was recorded in non-start mode or an **S** if the event was recorded in start mode.

Once an event playback sequence has been performed the **E** prefixed to the digital display will be removed. All event data is still available for playback until the data is erased. The display will be prefixed with an **E** again on the next power up cycle if the old data has not been erased or if another event is recorded.

(2) Foot-Pound Engine Torquemeters. The indicator displays the measured torque concurrently in a 1 alphabetic, 3 ½-numeric character digital display, and a 41-segment bar graph display. The indicator has a digital display range of 0 to 2600 ft-lb. The bar graph display range is 0 to 2600 ft-lb.

The display resolution is 10 ft-lb. for the digital section; 250 ft-lb. for the bar graph section in the 0 to 1000 ft-lb. range, 50 ft-lb. in the 1000 to 2000 ft-lb. range, 25 ft-lb. in the 2000 to 2300 ft-lb. range, and 100 ft-lb. in the 2300 to 2600 ft-lb. range.

The display will contain dashes (------) when the measured torque is greater than 2600 ft-lb. The dashes will be prefixed with an **F** if an EEPROM failure has been detected or with an **E** if an event has been stored and not played back. The **F** display shall take precedence over the **E** display.

The indicator has a BIT test for the LCD display, ROM (program memory), RAM (volatile data memory), EEPROM (non-volatile memory), and the signal input path. The display BIT will consist of displaying all active LCD segments for 3 seconds on power up. If the RAM or ROM BIT fails the indicator display shall be blanked. If the input signal fails BIT, the indicator will display "0" on both the digital and bar graph displays. BIT failures are NOT stored in EEPROM. Once the power is cycled the display is not affected unless the failure is again detected.

Exceedence events will be stored in EEPROM memory. Each event record will consist of two 16 bit words. One word will contain the peak torque measured during the event and the other word shall contain the event duration in seconds. A maximum of 50 events shall be recorded. If more than 50 events are recorded, only 50 will be stored. As new events are recorded, the oldest events shall be discarded. The indicator will prefix the digital display with an **E** when an event is being or has been recorded and not played back.

The indicator digital display will start flashing whenever indicated torque exceeds 2230 ft-lb. The flashing will stop and the digital torque display will be prefixed with an **E** when the time/torque combination is exceeded and the indicator begins recording an exceedence.

NOTE

Pressing the EXCEEDENCE ERASE switch for 0.2 seconds or longer will cause all events to be erased from non-volatile memory. There is no provision for erasing individual events.

Event display will take precedence over normal digital display. The bar graph will continue to display current engine torque data. To activate the event display, press the **EXCEEDENCE DISPLAY** switch for 0.2 seconds or longer. The event display will consist of the following:

1. The event number will be displayed for 2 seconds.

2. The event peak torque value will be displayed for 2 seconds.

3. The event duration, in seconds, will be displayed for 2 seconds.

All three data items displayed during playback will be prefixed with a **P** unless an EEPROM BIT failure has been detected in which case the display will be prefixed with an **F**. Once an event playback sequence has been performed, the **E** prefixed to the digital display shall be removed. All event data is still available for playback until the data is erased. The display will be prefixed with an **E** again on the next power up cycle if the old data has not been erased or if another event is recorded.

(3) Turbine Tachometers. The indicator displays the measured N_1 concurrently in a 1

alphabetic, 3 ½-numeric character digital display and a 39 segment bar graph display. The bar graph display is nonlinear. The indicator has a digital display range of 0 to 110.0% RPM while displaying current N_1 and 0 to 199.9% RPM while displaying exceedence N_1. The bar graph display range is 0 to 105.0% RPM.

The digital display shall contain dashes (------) when the measured N1 is greater than 110.0% RPM. When displaying EXCEEDENCE N1 values, the actual measured value, not "-----", shall be displayed, up to 199.9% RPM.

The indicator shall perform BIT on the LCD display, ROM, RAM, EEPROM, and input signal. The display BIT will consist of displaying all active LCD segments for 3 seconds on power up. If the ROM or RAM fails BIT the indicator display will be blank. If the input signal fails BIT the indicator will display 0 on both the digital and bar graph displays. If the EEPROM BIT fails the indicator will prefix the digital display with **F**. BIT failures shall not be stored in EEPROM. Failures detected will not affect the display after power is cycled unless the failure is again encountered.

Exceedence events will be stored in EEPROM memory. Each event record will consist of two 16-bit words. One word will contain the peak percent RPM measured during the event and the other word shall contain the event duration in seconds. A maximum of 50 events shall be recorded. If more than 50 events are recorded, only 50 shall be stored. As new events are recorded, the oldest events shall be discarded.

The indicator shall prefix the digital display with an **E** when an event is being or has been recorded and not played back. The indicator will start recording an event immediately when the indicator has measured percent RPM greater than 102.6 or when the indicator has measured percent RPM above 101.5 continuously for 10 seconds. The indicator will end recording and store the event when the measured percent RPM drops to 101.5 or lower.

NOTE

Pressing the EXCEEDENCE ERASE switch for longer than 0.2 seconds will cause all events to be erased from non-volatile memory. There are no provisions for erasing individual events.

To initiate the event display, press the **EXCEEDENCE DISPLAY** switch for 0.2 seconds or longer. Each event display will consist of the following cycle:

1. The event number will be displayed for 2 seconds.
2. The event peak percent RPM shall be displayed for 2 seconds.
3. The event duration, in seconds, will be displayed for 2 seconds.

All three data items displayed during playback shall be prefixed with a **P** unless an EEPROM BIT failure has been detected in which case the display will be prefixed with an **F**.

Once an event playback sequence has been performed, the **E** prefixed to the digital display will be removed. All event data is still available for playback until the data is erased. The display will be prefixed with an **E** again on the next power up cycle if the old data has not been erased or if another event is recorded.

(4) Engine Oil Pressure and Temperature Indicator. The indicator displays the measured engine oil pressure and engine oil temperature on two separate 23-segment nonlinear bar graph displays. The oil pressure indicator has a bar graph display range of 0 to 200 psi. The engine oil temperature portion of the gauge has a range of 0 to 120 °C. The segment display resolution for the oil pressure is 20 psi in the 0 to 60 psi range, 5 psi in the 60 to 140 psi range, and 20 psi in the 140 to 200 psi range.

The indicator has a BIT on the LCD display, ROM, RAM, and the signal input path. The display BIT consists of displaying all active LCD segments for 3 seconds on power up. If the ROM or RAM BIT fails the indicator display will be blank. If the input signal fails BIT the indicator shall display 0 psi.

(5) Fuel Flow Indicator. The indicator shall display the measured fuel flow concurrently in a 1 alphabetic, 3 ½-numeric character display and a 41-segment bar graph display.

The indicator has a digital display range of 0 to 600 pounds per hour. The bar graph displays a range of 0 to 600 pounds per hour. The digital display will contain dashes (------) when the measured fuel flow is greater than 600 pounds per hour.

The indicator shall perform BIT testing on the LCD display, ROM, RAM, and the signal input path. The display BIT consists of displaying all active LCD segments for 3 seconds on power up. The signal input BIT verifies the range of the incoming signal. If the ROM or RAM fails BIT the indicator display will be blanked. If the input signal fails BIT the indicator shall display "0" on both the digital and bar graph display.

c. Engine Instruments **F3** **.** Engine instruments, located on the left of the center position of the instrument panel, are grouped according to their function. At the top, the ITT indicators and torquemeters are used to set takeoff power. Climb and cruise power are established with the torquemeters and propeller tachometers while observing ITT limits. Gas generator (N_1) operation is monitored by the gas generator tachometers. The lower grouping consists of the fuel flow indicators and the oil pressure/temperature indicators.

(1) The ITT indicator gives an instantaneous reading of engine gas temperature between the compressor turbine and the power turbines. This ITT reading is self-generating.

(2) The torquemeters give an indication of foot-pounds of torque being applied to the propeller. The instruments are powered by 26 Vac power through the left and right torquemeter circuit breakers respectively, located on the right side panel.

(3) The N_1 or gas generator tachometer is read in percent of RPM, based on a figure of 37,500 RPM at 100%. Maximum continuous gas generator speed is limited to 38,100 RPM or 101.5% N_1. Both readings are self-generating.

(4) Oil pressure and temperature are indicated on two gauges, one for the left engine oil pressure and temperature and an identical gauge for the right engine. These dc gauges are powered by the No. 1 and No. 2 dual feed buses respectively, and are protected by 5-ampere circuit breakers, placarded **OIL PRESS** and **OIL TEMP**, located on the right sidewall circuit breaker panel.

(5) Two gauges indicate the rate of flow for consumed fuel as measured by sensing units coupled into the fuel supply lines for each engine. The fuel flow indicators are calibrated in increments of hundreds of pounds per hour. The left engine indicator is powered by the No.1 dual feed bus and the right is powered by the No, 2 dual feed bus. Both indicators are protected by 5-ampere circuit breakers, placarded **FUEL FLOW**, located on the right sidewall circuit breaker panel.

Proper observation and interpretation of these instruments provide an indication of engine performance and condition.

2-31. ENGINE TREND MONITOR.

a. General Description. The Engine Trend Monitor (ETM) is a monitoring system that monitors and records data on engine and airframe parameters, e.g., fuel used, cycle counts, total hours, and engine and airframe exceedences. It provides automatic cycle and engine start counting and automatic data collection. The ETM provides maintenance personnel with a complete, accurate, and detailed record of the engine and airframe use. At the time of first installation of the ETM in the aircraft, the data in the ETM is revised with the current pertinent statistical data concerning the airframe and engines. The ETM can also serve as a log that will contain detailed records of each event in a flight from power on, engine starts to engine stops, and power off.

NOTE

When the ETM system is inoperative, pilots are responsible for manually recording engine trend data.

b. System and Related Components.

(1) The ETM Processor. The processor contains the main computer, and is the collection point for data received from the various engine transducers.

(2) The Airdata Computer. **T3** **F3** The Airdata computer provides airdata calculations and is interfaced to the KLN90B GPS receiver. **R** The Airdata computer provides airdata calculations and is the interface to the GNS-XLS FMS.

(3) The Display & Key Recorder. The Display and Key Recorder is a cabin-mounted display that houses both the key recorder equipment and display interface.

(4) Indicator Light. An indicator light, labeled **ETMS**, is located on the right side of the instrument panel below the stormscope. The **ETMS** indicator light illuminates when the ETM is recording data and for 10 seconds after the master switch is turned on.

c. Normal Operations. When the master switch is turned on, power is applied to the ETM causing the **ETMS** indicator light to illuminate and the ETM to perform a self-test. It is vital that the pilot follow certain procedures when starting up and shutting down the aircraft in accordance with the following:

(1) When starting the aircraft, wait a full 10 seconds before starting the engines after turning on the master switch to allow the ETM to complete its startup procedures.

(2) If the engines are started before the ETM has completed its startup sequence, the system will not record any engine starts. This will result in inaccurate cycle counts, engine start counting, and trend analysis.

(3) When shutting down the engines, wait until the gas generator speeds of both engines drop below 10% prior to turning off the master switch.

(4) During aircraft operation, the ETM monitors and records data on the engine and airframe parameters and notifies maintenance personnel when the established limits of those parameters are exceeded. This data is, in turn, used for later trend analysis. The ETM has a secure feature that prevents unauthorized changes to the retained statistical data being recorded.

Section IV. FUEL SYSTEM

2-32. FUEL SUPPLY SYSTEM.

The engine fuel supply system, Figure 2-18, consists of two separate but identical systems sharing a common fuel management panel, Figure 2-19, and fuel crossfeed plumbing, Figure 2-20. Each main fuel system consists of five interconnected wing tanks and a nacelle tank. Each auxiliary fuel system consists of one tank located between the nacelle and the fuselage. A fuel transfer pump is located within each auxiliary tank. Additionally, the system has an engine-driven boost pump, a standby fuel pump located within each nacelle tank, a fuel heater (engine oil-to-fuel heat exchanger unit), a tank vent system, tank vent heating system, and interconnecting wiring and plumbing. Total fuel tank capacity is shown in Table 2-2. Gravity feed fuel flow is shown in Figure 2-21.

a. Fuel Tanks*.* The main wing tanks consist of two leading edge tanks, two box section bladder tanks, and an integral (wet cell) tank all interconnected to flow into the nacelle tank by gravity. This system of tanks is filled from the filler located near the wing tip. The auxiliary fuel system consists of a center section tank, located in the inboard wing, with its own filler opening and an automatic fuel transfer system to transfer the fuel into the nacelle tank. An anti-siphon valve is installed at each filler port to prevent loss of fuel or collapse of a fuel cell bladder in the event of improper securing or loss of the filler cap. The nacelle tank is located directly behind the engine and contains a submerged, electrically operated standby fuel pump. The fuel from the nacelle tank is fed directly into the engine by either the engine-driven primary fuel pump or, as backup, the standby fuel pump. The quantity of fuel for the tanks is detailed in Table 2-3.

b. Engine-Driven Boost Pumps*.* A gear-driven boost pump mounted on each engine, supplies fuel, under pressure, from the nacelle tank to the inlet of the engine-driven primary high-pressure pump for engine starting and all normal operations. Either the engine-driven boost pump or electric standby pump is capable of supplying sufficient pressure to the engine-driven primary high-pressure pump, maintaining normal engine operation.

CAUTION

Engine operation using only the engine-driven primary (high-pressure) fuel pump without standby pump or engine-driven boost pump fuel pressure is limited to 10 cumulative hours.

NOTE

This condition is indicated by illumination of both the L or R FUEL PRESS warning annunciator and the simultaneous illumination of both MASTER WARNING annunciators. All time in this category shall be entered on DA Form 2408-13-1 for the attention of maintenance personnel.

c. Standby Fuel Pumps. A submerged, electrically operated standby fuel pump, located within each nacelle tank, serves as a backup unit for the engine-driven boost pump. The standby pumps are switched off during normal system operations. A standby fuel pump will be operated during crossfeed operation to pump fuel from one nacelle tank to the opposite engine. Each standby fuel pump has an inertia switch included in the power supply circuit. When subjected to a 5 to 6 G shock loading, as in a crash situation, the inertia switch will remove electrical power from the standby fuel pumps. The standby fuel pumps are protected by two 10-ampere circuit breakers, placarded **LEFT** or **RIGHT STANDBY PUMP**, located on the left sidewall circuit breaker panel, and, on the R models, four 5-ampere circuit breakers (two each in parallel) on the hot battery bus.

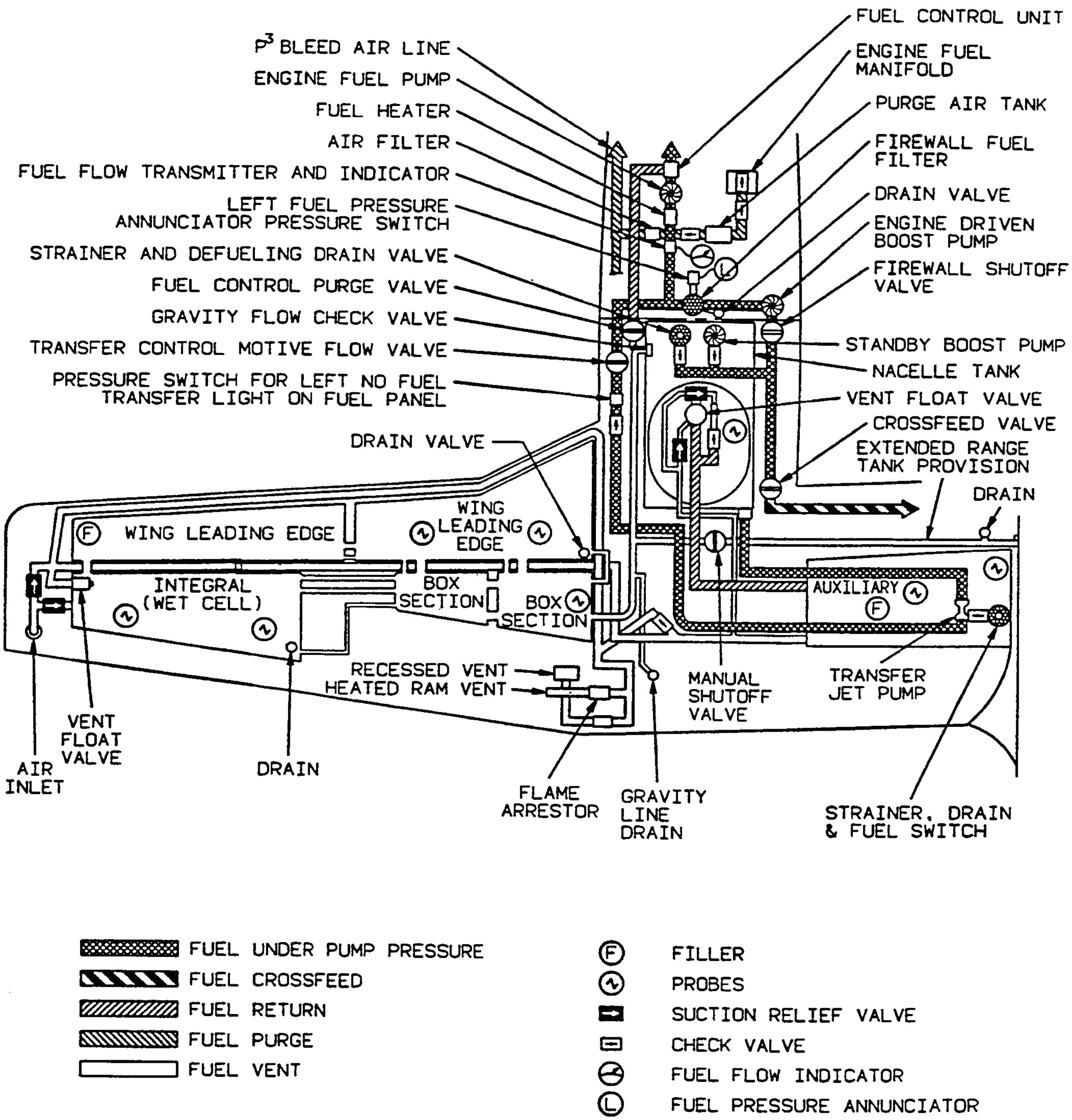


Figure 2-18. Fuel System Schematic

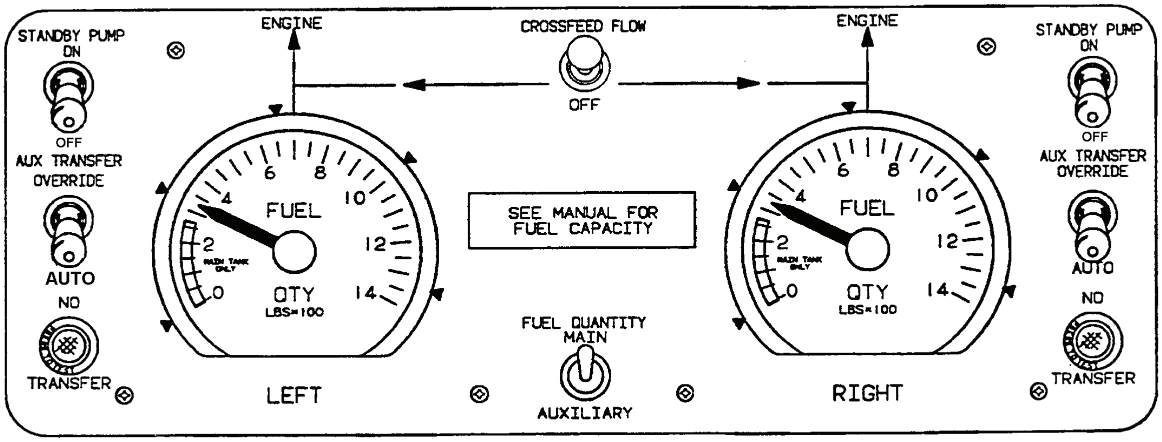


Figure 2-19. Fuel Management Panel

Table 2-2. Usable Fuel Quantity Data

	TANKS	NUMBER	GALLONS
LEFT ENGINE	Main Tanks Auxiliary Tank (Ferry Fuel Tank)	6 1 (1)	193 79 (120)
RIGHT ENGINE	Main Tanks Auxiliary Tank (Ferry Fuel Tank)	6 1 (1)	193 79 (120)
*TOTALS		14	544
*(TOTALS with Ferry Fuel Tanks Installed)		(16)	(784)
*Unusable fuel quantity not included in totals.			

Table 2-3. Fuel Quantity Data

	TANKS	NUMBER	GALLONS	**POUNDS
LEFT ENGINE	Wing tanks Nacelle tank Auxiliary tank (Ferry tank) ***	5 1 1 (1)	136 57 79 (120)	924.8 387.6 537.2 (816.0)
RIGHT ENGINE	Wing tanks Nacelle tank Auxiliary tank (Ferry tank) ***	5 1 1 (1)	136 57 79 (120)	924.8 387.6 537.2 (816.0)
*TOTALS		14	544	3699.2
*(TOTALS with Ferry tanks installed)		(16)	(784)	(5331.2)
* Unusable fuel quantity and weight (4 gallons, 26 pounds not included in totals).				
** Fuel weight is based on standard day conditions at 6.8 pounds per U.S. gallon. Total fuel system capacity is 548 gallons.				
*** Data for Ferry tanks is included when they are installed.				

NOTE

Both standby pump switches will be off during crossfeed operation.

NOTE

The engine-driven primary (high-pressure) fuel pump is limited to 10 hours of operation throughout its TBO period, without stand-by fuel pump or engine-driven boost pump fuel pressure.

NOTE

The diagram shows typical fuel crossfeed situation with left wing fuel system supplying both engines (all boost and standby pumps operable). For selection of right wing fuel for crossfeed, reverse cross-feed switch position. Either configuration will supply either engine during single engine operation. Fuel will not cross transfer between tank systems.

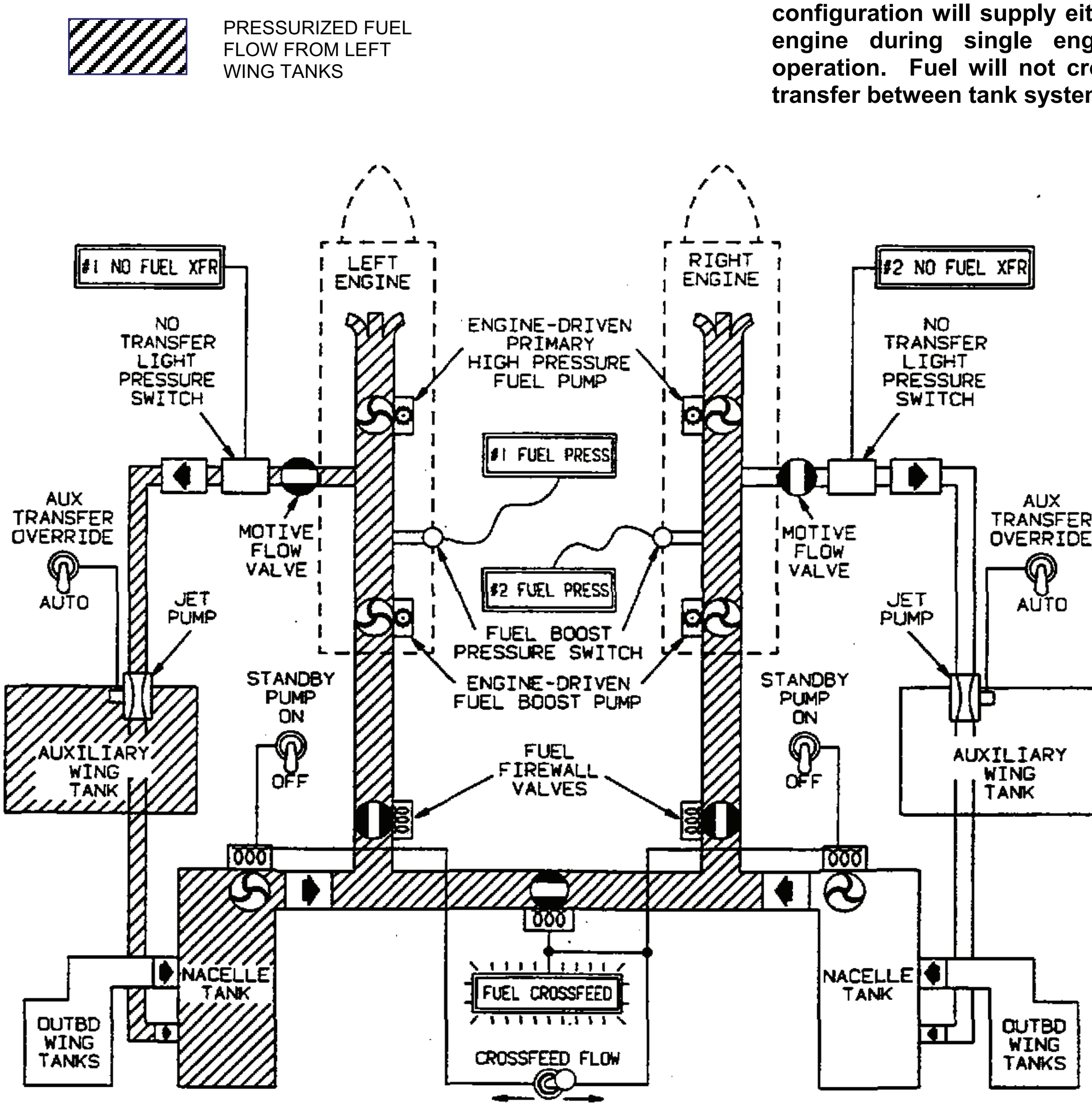


Figure 2-20. Crossfeed Fuel Flow

NOTE

If an engine driven boost pump fails, pressure can be maintained by placing the respective standby pump switch to ON.

NOTE

The engine-driven primary (high-pressure) fuel pump is limited to 10 hours of operation, throughout its TBO period, without standby fuel pump or engine-driven boost pump fuel pressure.

NOTE

The system will suction-lift fuel only to its respective engine-driven boost pump i.e., left or right. Fuel will not gravity feed through the crossfeed system.

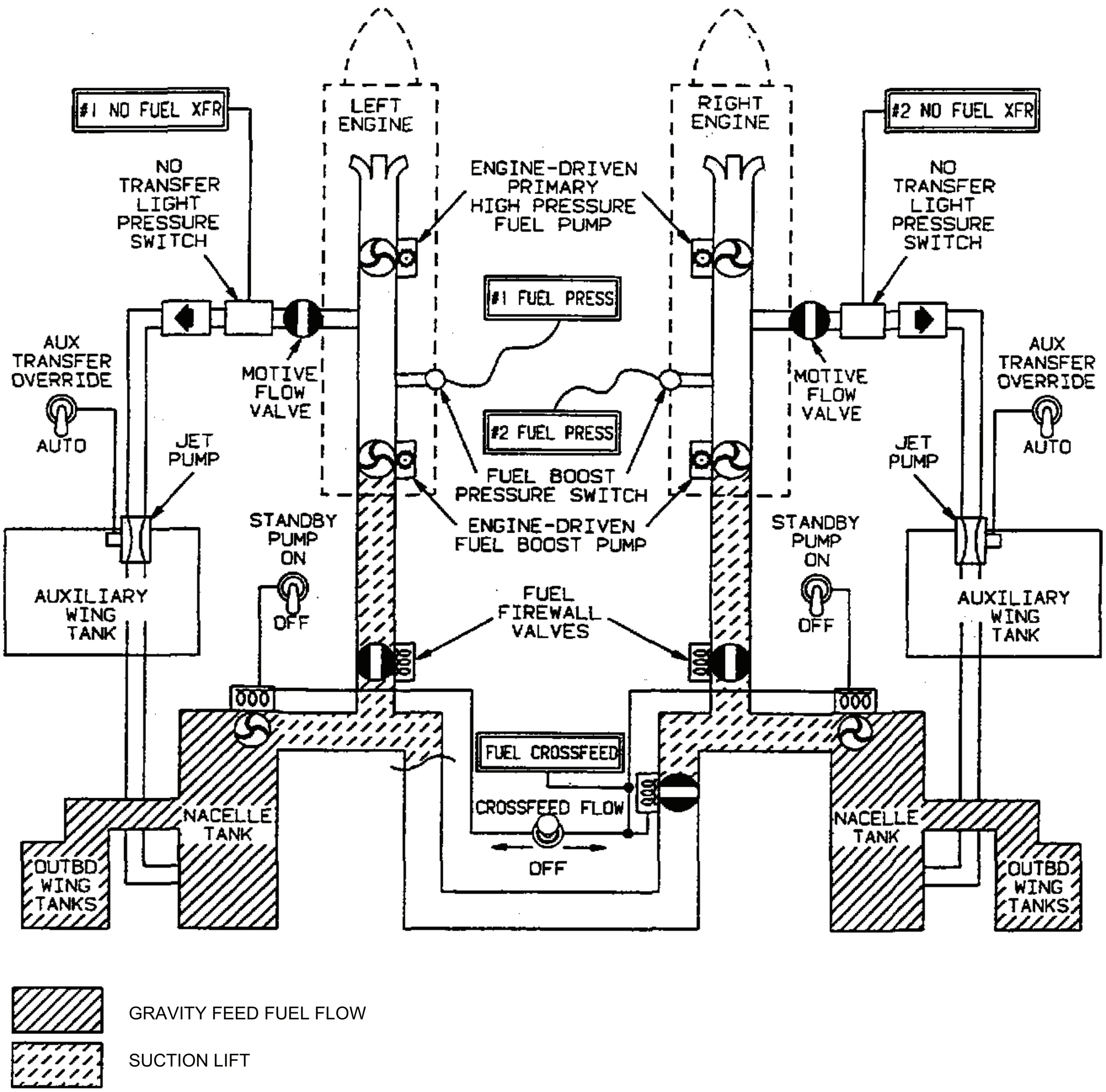


Figure 2-21. Gravity Feed Fuel Flow

NOTE

In turbulence or during maneuvers, the NO TRANSFER indicator lights may momentarily illuminate after the auxiliary fuel has completed transfer.

d. Fuel Transfer Pumps. The auxiliary tank fuel transfer system automatically transfers the fuel from the auxiliary tank to the nacelle tank without pilot action. Motive flow to a jet pump mounted in the auxiliary tank sump is obtained from the engine fuel plumbing system downstream from the engine driven boost pump and routed through the transfer control motive flow valve. The motive flow valve is energized to the open position, by the control system, to transfer auxiliary fuel to the nacelle tank to be consumed by the engine during the initial portion of the flight. When an engine is started, pressure at the engine driven boost pump closes a pressure switch, which, after a 30 to 50 second time delay to avoid depletion of fuel pressure during starting, energizes the motive flow valve. When auxiliary fuel is depleted, a low-level float switch de-energizes the motive flow valve after a 30 to 60 second time delay. This time delay function prevents cycling of the motive flow valve due to sloshing fuel. If the motive flow valve or associated circuitry fails, the loss of motive flow pressure, when there is still fuel remaining in the auxiliary fuel tank, is sensed by a pressure switch which illuminates a yellow left or right indicator light on the fuel management panel, placarded **NO TRANSFER**. During engine start, the pilot should note that the **NO TRANSFER** indicator light extinguishes 30 to 50 seconds after engine start. If auxiliary tanks are empty, the **NO TRANSFER** indicator light will not illuminate. A manual override is incorporated as a backup for the automatic transfer system. Manual override is initiated by placing the **AUX TRANSFER** switch, located on the fuel management panel, to the **OVERRIDE** position. This will energize the transfer control motive flow valve. The transfer systems are protected by two 5-ampere circuit breakers, placarded **AUX TRANSFER LEFT / RIGHT**, located on the left sidewall circuit breaker panel.

e. Fuel Gauging System. Fuel quantity is measured by a capacitance-type fuel gauging system. Two fuel gauges, one for the left and one for the right fuel system, read fuel quantity in pounds. A maximum of 3% error may be encountered in each system; however, the system is compensated for fuel density changes due to temperature excursions.

f. Fuel Management Panel. The fuel management panel is located on the left cockpit sidewall. It contains the fuel gauges, standby fuel pump switches, crossfeed valve switch, fuel gauging system control switch, **NO TRANSFER** indicator lights, and auxiliary transfer override switches.

(1) Fuel Gauging System Control Switch. A switch on the fuel management panel, placarded **FUEL QUANTITY MAIN / AUXILIARY**, controls the fuel gauging system. When the switch is in the **MAIN** position, the fuel gauges read the total fuel quantity in the left and right main fuel systems. When the switch is in the **AUXILIARY** position, the fuel gauges read the fuel quantity in the left and right auxiliary tanks only.

(2) Standby Fuel Pump Switches. Two switches on the fuel management panel, placarded **STANDBY PUMP ON / OFF**, individually control a submerged fuel pump located in the corresponding nacelle tank. During normal aircraft operation, both switches should be off so long as the engine-driven boost pumps are operative.

NOTE

Both STANDBY PUMP switches shall be off during crossfeed operation. The loss of fuel pressure due to failure of an engine-driven boost pump will illuminate the MASTER WARNING annunciators on the glareshield, and will illuminate the respective L FUEL PRESS or R FUEL PRESS annunciator on the warning annunciator panel. Turning ON the STANDBY PUMP will extinguish the FUEL PRESS annunciator. The MASTER WARNING annunciators must be manually reset.

(3) Auxiliary Fuel Transfer Override Switches. Two switches on the fuel management panel, placarded **AUX TRANSFER OVERRIDE / AUTO**, individually control operation of the fuel transfer pumps. During normal operation both switches are in **AUTO**, which allows the system to be automatically actuated. If either transfer system fails to operate, on the **R** models the fault condition is indicated by the **MASTER CAUTION** annunciators on the glareshield and, on both the **R** and **F3/T3** models a steadily illuminated yellow left or right **NO TRANSFER** indicator light on the fuel management panel.

(4) Fuel Crossfeed Switch. The fuel crossfeed valve is controlled by a 3-position switch, placarded **CROSSFEED FLOW / OFF**, located on the fuel management panel. Under normal flight conditions the switch is left in the **OFF** position. During emergency-single engine operation, it may become necessary to supply fuel to the operative engine from the fuel system on the opposite side. The crossfeed system is placarded for fuel system selection with a simplified diagram on the fuel control

panel. Place the **STANDBY PUMP** switches in the **OFF** position when crossfeeding. A lever lock switch, placarded **CROSSFEED FLOW**, is moved from the center **OFF** position to the left or to the right, depending on direction of fuel flow desired, to open the crossfeed valve and energize the standby pump on the side from which crossfeed is desired. During crossfeed operation with firewall fuel valve closed, auxiliary tank fuel will not crossfeed. When the crossfeed mode is energized, a green **FUEL CROSSFEED** annunciator on the caution/advisory panel will illuminate. Crossfeed system operation is described in Chapter 9. The crossfeed valve is protected by a 5-ampere circuit breaker, placarded **CROSSFEED**, located on the left sidewall circuit breaker panel.

CAUTION

Do not use the fuel firewall shutoff valve to shut down an engine, except in an emergency. The engine-driven high-pressure fuel pump obtains essential lubrication from fuel flow. When an engine is operating, this pump may be severely damaged (during cavitation) if the firewall valve is closed before the CONDITION lever is moved to the FUEL CUTOFF position.

g. Firewall Shutoff Valves. The fuel system incorporates a fuel line shutoff valve mounted aft of each engine firewall. Two guarded switches, placarded **FIREWALL SHUTOFF VALVE OPEN / CLOSED LEFT / RIGHT**, located on the left sidewall circuit breaker panel control the firewall shutoff valves. The firewall shutoff valves receive electrical power from the main buses, and also from the hot battery bus which is connected directly to the battery. The valves are protected by 5-ampere circuit breakers, placarded **FIREWALL VALVE LEFT / RIGHT**, on the left sidewall circuit breaker panel.

h. Fuel Tank Sump Drains. A sump drain wrench is provided in the aircraft loose tools to simplify draining a small amount of fuel from the sump drain.

(1) There are five sump drains and one filter drain in each wing. Refer to Table 2-4.

(2) An additional drain for the ferry fuel system line extends through the bottom of the wing center section adjacent to the fuselage. Any time the ferry fuel system is in use, the preflight inspection includes draining a small amount of fuel from this drain to check for fuel contamination. Whenever the ferry fuel system is removed from the aircraft and the fuel line is capped off in the fuselage, drain the remaining fuel in the line.

(3) Each ferry fuel tank has a 10-foot 1/4-inch flex hose with a quick drain installed in the aft end. When the ferry fuel system is in use, the preflight inspection also includes draining a small amount of fuel from these drains to drain off any moisture that may have been inadvertently introduced into the tanks. Place the aft end of the hoses out through the cabin entrance door, hold a fuel-proof container under the ends, and drain about a pint of fuel out of each line.

i. Fuel Purge System. Each engine is provided with a fuel purge system. The system is designed to ensure that any residual fuel in the fuel manifolds is consumed during engine shutdown. During engine operation, compressor discharge air is routed through a filter and check valve, pressurizing a small air tank mounted on the engine truss. On engine shutdown the pressure differential between the air tank and fuel manifolds causes air to be discharged from the air tank, through a check valve, and into manifolds, out through the nozzles and into the combustion chamber. The fuel forced into the combustion chamber is consumed, causing a momentary rise in engine ITT.

Table 2-4. Fuel Sump Drain Locations

NUMBER	DRAINS	LOCATION
1	Leading Edge Tank	Outboard of nacelle, underside of wing
1	Integral Tank	Underside of wing, forward of aileron
1	Firewall Fuel Filter	Underside of cowling forward of firewall
1	Sump Strainer	Bottom center of nacelle forward of wheel well
1	Gravity Feed Line	Aft of wheel well
1	Auxiliary Tank	At wing root, just forward of flap
1	Ferry Fuel	Outboard of fuselage on underside of wing center section

j. Fuel Vent System. Each fuel system is vented through two ram vents located in the underside of the wing adjacent to the nacelle, and a secondary vent, located near the wing tip. To prevent icing of the vent system, one vent is recessed into the wing and the other ram vent protrudes out from the wing and contains a heating element. The vent line at the nacelle contains an inline flame arrester.

k. Engine Oil-to-Fuel Heat Exchanger. An engine oil-to-fuel heat exchanger, one located on each engine accessory case, operates continuously during engine operation to heat fuel delivered to the engine to prevent the freezing of water that the fuel may contain.

2-33. FUEL SYSTEM MANAGEMENT.

a. Fuel Transfer System. When the auxiliary tanks are filled, they will be used first, then the fuel in the wing tanks. During transfer of auxiliary fuel, which is automatically controlled, the nacelle tanks are maintained full. A check valve in the gravity feed line from the outboard wing prevents reverse fuel flow. Normal gravity transfer of the main wing fuel into the nacelle tanks will begin when auxiliary fuel is exhausted. The system will gravity feed fuel only to its respective nacelle tank, i.e., left or right. Fuel will not gravity feed through the crossfeed system.

b. Operation with Failed Engine-Driven Boost Pump and Standby Pump. Two boost pumps in each fuel system provide inlet head pressure to the engine-driven primary high-pressure fuel pump. If crossfeed is used, a third pump (the standby fuel pump from the opposite system) will supply the required pressure. Operation under this condition will result in an unbalanced fuel load, as fuel from one system will be supplied to both engines while all fuel from the system with the failed boost pumps will remain unused.

2-34. FERRY FUEL SYSTEM.

NOTE

The ferry fuel system is installed in the aircraft for the specified ferry flight only.

a. Ferry Fuel System. The ferry fuel system consists of two 120-gallon aluminum fuel tanks, a ferry fuel system control assembly, and a 115-cubic foot oxygen bottle. The ferry fuel tanks each contain an electric rotary pump and a manual wobble pump for pumping fuel to the nacelle tank. The fuel tanks are mounted on the left and right side seat tracks on each side of the cabin, the fuel control assembly is mounted across the aisle directly behind the pilot and copilot seats, and the add on oxygen bottle is mounted on the aft baggage compartment floor. Permanently installed provisions for connecting the ferry fuel system to the nacelle tank are included in the fuel system. The provisions consist of manually operated shutoff valves in each wheel well, a fuel drain, and fuel lines which are routed from each wing to the nacelle tank. The fuel drain, located on the underside of the wing center section adjacent to the fuselage, should be drained after each use of the ferry fuel system. The ferry tanks are connected to fuel lines that lead to the nacelle tank.

b. Ferry Fuel Transfer.

NOTE

When ferry fuel is transferred with the aircraft pressurized, the ferry fuel will be transferred rapidly due to the cabin pressure differential. The rapid transfer of fuel occurs when any ferry fuel tank selector valve and any aircraft fuel tank selector valve is open and doesn't require operating either the electric fuel pumps or the manual wobble pump. The one-way check valve in the surge tank, marked IN, equalizes the cabin pressure and the air pressure over the fuel in the ferry fuel tanks. Opening the selector valves, as noted above, opens a path for the fuel to the main aircraft fuel tanks, which have only ambient pressure over the fuel. Cabin pressure will force the fuel out of the ferry fuel tanks into the aircraft main fuel tanks, i.e., from the pressurized area into the unpressurized area.

Transfer of fuel from either of the ferry fuel tanks first will not affect the aircraft center of gravity.

(1) In preparation for transfer of fuel from the ferry fuel tanks to the main fuel tanks, use fuel from both main fuel tanks until each is about ½ full. Open the desired ferry fuel selector valve and open either or both fuel tank selector valve(s).

(2) Turn on either or both ferry fuel pump(s) to transfer fuel to the main fuel tank(s). Monitor the quantity of fuel in the main fuel tanks and discontinue ferry fuel transfer when the main fuel tanks near the full mark to prevent venting fuel overboard. If either of the aircraft fuel tanks seems to be nearing the full mark before the other, discontinue fuel transfer and level the tanks in accordance with the approved Pilots' Operating Handbook before resuming fuel transfer again.

(3) Observe the fuel-flow sight gauge in the line from the ferry fuel pump to the fuel tank selector valves for air bubbles. When air bubbles begin to

appear in the sight gauge, you may assume that the selected ferry fuel tank is empty. As each ferry fuel tank reaches empty, close that selector valve and either select the other tank and/or turn off the transfer pump(s). When the ferry fuel system is depleted, securely close all selector valves and turn off the transfer pumps.

Section V. FLIGHT CONTROLS

2-35. FLIGHT CONTROL SYSTEM.

The aircraft's primary flight control system consists of conventional rudder, elevator, and aileron control surfaces. These surfaces are manually operated from the cockpit through mechanical linkage using a control wheel for the ailerons and elevators, and adjustable rudder/brake pedals for the rudder. Both the pilot and copilot have flight controls. Trim control for the rudder, elevators, and ailerons is accomplished through a manually actuated cable-drum system for each set of control surfaces. The autopilot has provisions for controlling the position of the ailerons, elevators, elevator trim tab, and rudder.

2-36. CONTROL WHEELS.

Elevator and aileron control surfaces are operated by manually actuating either the pilot's or copilot's control wheel. Refer to Figure 2-22. A control wheel is installed on each side of the instrument panel. Switches are installed in the outboard grip of each wheel to operate the elevator trim tabs. A microphone switch; an autopilot/yaw damp/electric trim disconnect switch; and a pitch synchronize and control wheel steering switch are also installed in the outboard grip of each control wheel. The outboard grip of the copilot's control wheel also has a GO AROUND (**GA**) switch. A transponder ident switch is installed on the forward side of the inboard grip of each control wheel. Installed in the center of each control wheel is a digital electric clock. A map light switch is installed on the inboard grip of each control wheel.

2-37. RUDDER SYSTEM.

a. Rudder Pedals*.* Aircraft rudder control and nose wheel steering is accomplished by actuation of the rudder pedals from either the pilot's or copilot's station. The rudder pedals may be individually adjusted, forward or aft, to provide adequate legroom for the pilot and copilot. Adjustment is accomplished by pressing the lever alongside the rudder pedal arm and moving the pedal, forward or aft, until the locking pin engages in the selected position.

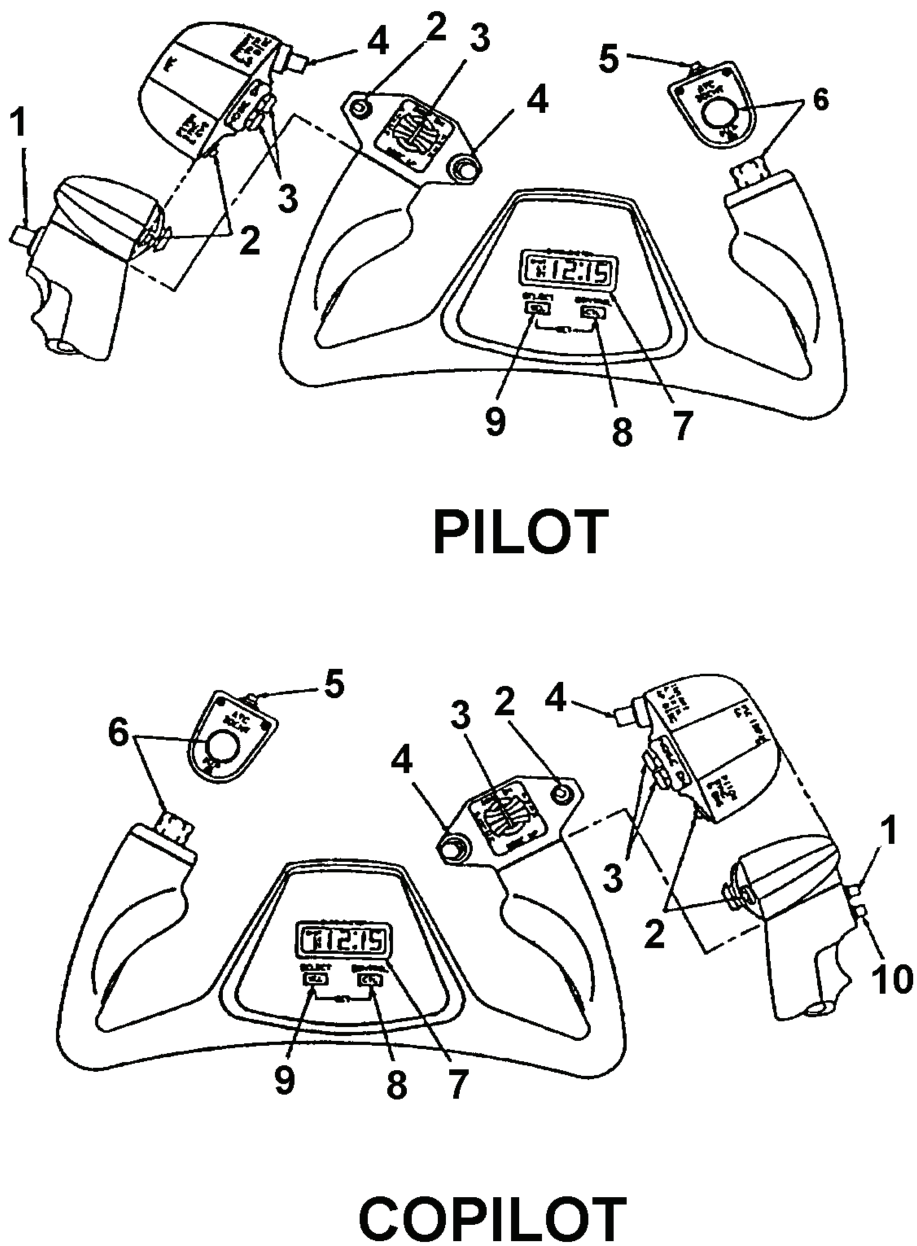
b. Yaw Damper System*.* A yaw damper system is provided to aid the pilot in maintaining directional stability and increase ride comfort. The system may be used at any altitude, but is required for flight above 17,000 feet when aircraft weight exceeds 12,500 pounds. It must be deactivated for takeoff and landing. The yaw damper system is a part of the autopilot. A Yaw Damper (**YD**) switch located on the autopilot control panel controls the system. The yaw damper may also be disconnected by pressing the control wheel autopilot/yaw damper/electric trim disconnect switch, placarded **AP DISC & TRIM INTRPT**, to the first level. Operating instructions for this system are contained in Chapter 3.

c. Rudder Boost System. Rudder boost is provided to aid the pilot in maintaining directional stability resulting from an engine failure or a large variation of power between the engines. Incorporated in the rudder cable system are two pneumatic rudder-boosting servos that actuate the cables to provide rudder pressure to help compensate for asymmetrical thrust. Rudder boost is not required for flight.

NOTE

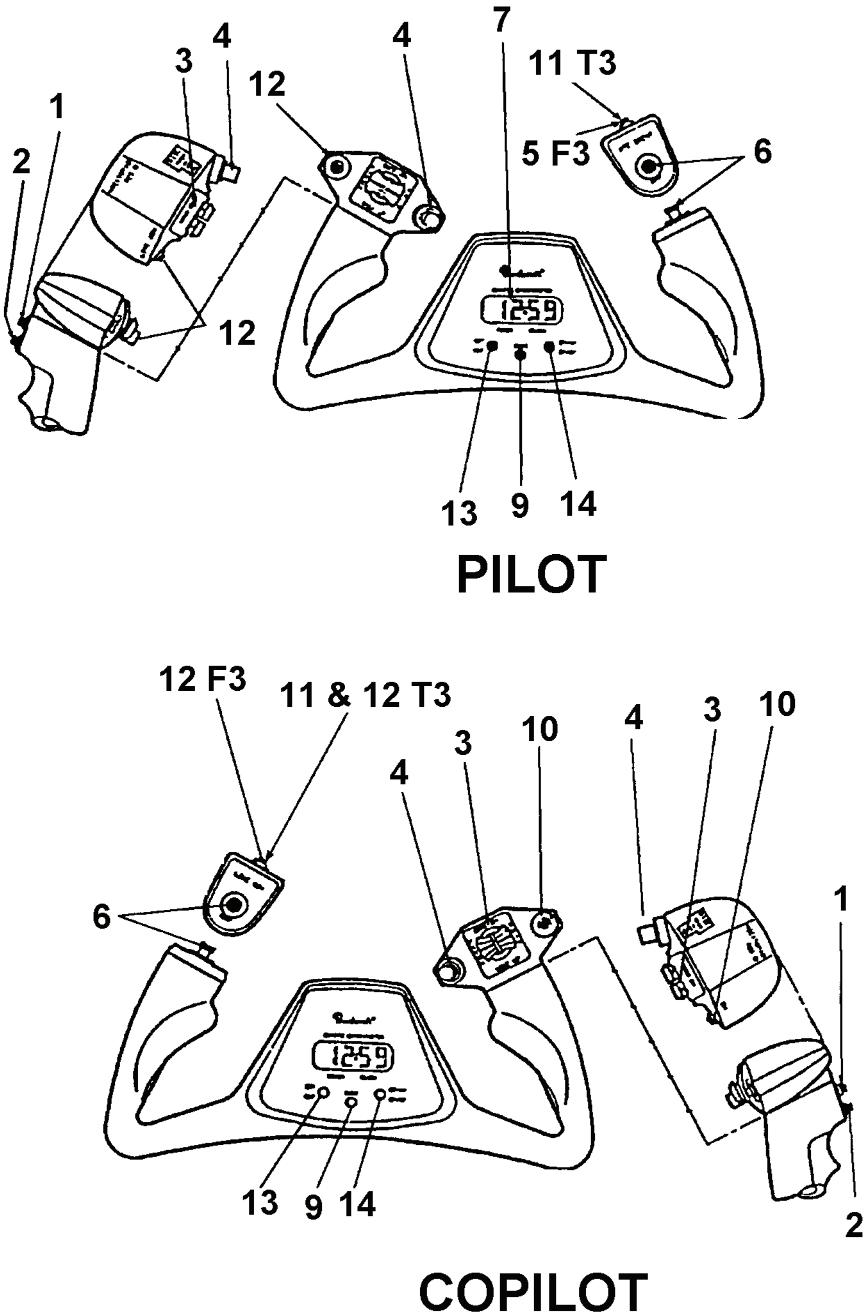
Rudder boost may be inoperative when brake deice is on.

(1) During operation, a differential pressure valve accepts bleed air pressure from each engine. When the pressure varies between the bleed air systems, the shuttle in the differential pressure valve moves toward the low-pressure side. As the pressure difference reaches a preset tolerance, a switch closes on the low-pressure side that activates the rudder boost system. This system is designed only to help compensate for asymmetrical thrust. Appropriate trimming is to be accomplished by the pilot. Moving either or both of the **BLEED AIR VALVES** switches on the copilot's subpanel to the **INSTR & ENVIR OFF** position will disengage the rudder boost system.



1. Microphone Switch
2. Pitch Synchronize and Control Wheel Steering Switch
3. Electric Elevator Trim Switches
4. Autopilot / Yaw Damper Electric Trim Disconnect Switch
5. Transponder Ident Switch
6. Map Light Switch
7. Chronometer Digital Display
8. Chronometer Control Push-Button Switch
9. Chronometer Mode Select Push-Button Switch
10. Go Around (GA) Switch

Figure 2-22. Control Wheels R (Sheet 1 of 2)



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6. Map Light Switch
7. Chronometer Digital Display
8. Chronometer Control Push-Button Switch
9. Chronometer Mode Select Push-Button Switch
10. Go Around (GA) Switch
11. Quicktune Switch
12. Line Advance Switch
13. Set / Reset Switch
14. DY – AV / ST – SP

Figure 2-22. Control Wheels **T3** **F3** *(Sheet 2 of 2)*

NOTE

Condition levers must be in LOW IDLE position to perform rudder boost check.

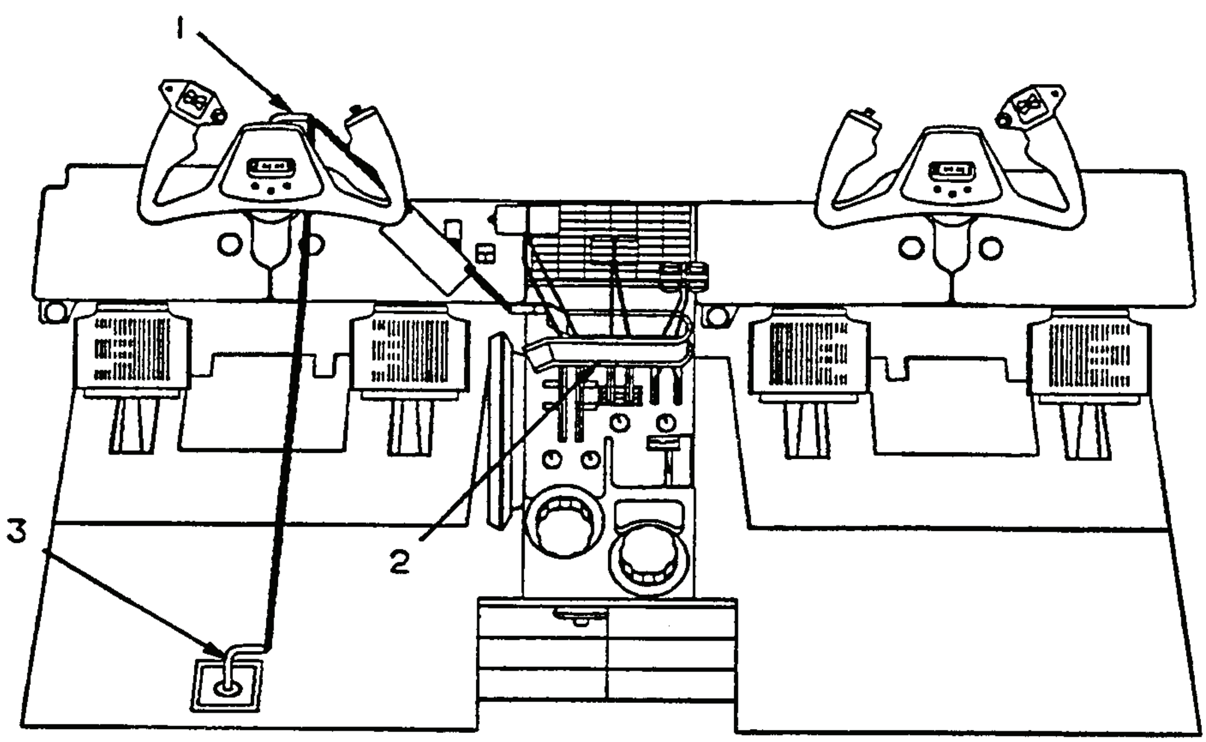
(2) The system is controlled by a switch, placarded **RUDDER BOOST** / **OFF**, located on the pedestal extension, and is to be turned on before flight. A preflight check of the system can be performed during the runup by retarding the power on one engine to idle and advancing power on the opposite engine until the power difference between the engines is great enough to activate the switch to turn on the rudder boost system. Movement of the appropriate rudder pedal (left engine idling, right rudder pedal moves forward) will be noted when the switch closes, indicating that the system is functioning properly for low engine power on that side. Repeat the check with opposite power settings to check for movement of the opposite rudder pedal. The system is protected by a 5-ampere circuit breaker, placarded **RUDDER BOOST**, located on the right sidewall circuit breaker panel.

2-38. FLIGHT CONTROL LOCKS.

CAUTION

Remove control locks before towing the aircraft or starting engines. Serious damage could result in the steering linkage if towed by a tug with the rudder lock installed.

A removable lock assembly consisting of two pins, and an elongated U-shaped strap interconnected by a chain provides positive locking of the rudder, elevator and aileron control surfaces, and engine controls (**POWER** levers, **PROP** levers, and **CONDITION** levers). Refer to Figure 2-23. Installation of the control locks is accomplished by inserting the U-shaped strap around the aligned control levers from the copilot's side; then the aileron/elevator locking pin is inserted through a guide hole in the top/bottom of the pilot's control column assembly. The rudder is held in a neutral position by an L-shaped pin that is installed through a guide hole in the floor aft of the pilot's rudder pedals. The rudder pedals must be centered to align the hole in the rudder bellcrank with the guide hole in the floor. Remove the locks in reverse order (rudder pin, control column pin, and power control clamp).



1. Aileron-Elevator Lock Pin
2. Engine Controls Lock Bar
3. Rudder Lock Pin

Figure 2-23. Control Locks

2-39. TRIM TABS.

Trim tabs are provided for all flight-control surfaces. These tabs are manually actuated, and mechanically controlled by a cable-drum and jackscrew actuator system, except the right aileron tab, which is of the fixed, pliable type. Elevator and aileron trim tabs incorporate neutral, non-servo action, i.e., as the elevators or ailerons are displaced from the neutral position, the trim tab maintains an as-adjusted position. The rudder trim tab incorporates anti-servo action, i.e., as the rudder is displaced from the neutral position, the trim tab moves in the same direction as the control surface. This action increases control pressure as the rudder is deflected from the neutral position.

a. Elevator Trim Tab Control. The elevator-trim tab control wheel, placarded **PITCH TRIM DN / UP**, is located on the left side of the control pedestal and controls a trim tab on each elevator. A position arrow indicates the amount of elevator tab deflection, in units from a neutral setting.

b. Electric Elevator Trim. Dual element thumb switches on the control wheels control the electric elevator trim system, and a trim disconnect switch on each control wheel. The system is protected by two 10-ampere circuit breakers, placarded **NO. 1** and **NO. 2 AP TRIM POWER**, located on the right sidewall circuit breaker panel. The dual element thumb switch is moved forward for trimming nose down and aft for nose up. When released, the switch returns to the center (off) position. Any activation of the trim system through the copilot's trim switch can be over-ridden by activation of the pilot’s switch. Simultaneously operating the pilot's and copilot's switches in opposing directions results in the pilot's having priority. An annunciator, placarded **ELEC TRIM OFF,** on the caution/advisory annunciator panel indicates failure or disconnect of the electric trim system.

c. A preflight check of the switches should be accomplished before flight by moving the switches individually on both control wheels. No one switch alone should operate the system; operation of elevator trim should occur only by movement of pairs of switches on each control wheel. The trim system disconnect is a bi-level push button momentary-type switch, located on the outboard grip of each control wheel, placarded **AP DISC & TRIM INTRPT**. Pressing the switch to the first of two levels disconnects the autopilot and yaw damper system, and the second level disconnects the electric trim system.

d. Aileron Trim Tab Control. The aileron-trim tab control, placarded **AILERON TRIM LEFT / RIGHT**, located on the control pedestal, adjusts the aileron trim tab. The amount of aileron tab deflection from a neutral setting, as indicated by a position indicator, is relative only and is not in degrees.

e. Rudder Trim Tab Control. The rudder trim tab control knob, placarded **RUDDER TAB LEFT / RIGHT**, located on the control pedestal, controls adjustment of the rudder trim tab. A position indicator denotes the amount of rudder tab deflection, in units from a neutral setting.

2-40. WING FLAPS.

The slot-type wing flaps are electrically operated and consist of two sections for each wing. These sections extend from the inboard end of each aileron to the junction of the wing and fuselage. During extension or retraction, the flaps are operated as a single unit, with each section actuated by a separate jackscrew actuator. The actuators are driven through flexible shafts by a single reversible electric motor. Wing flap position is indicated in percent of travel by a flap position indicator on the center subpanel. Full flap extension and retraction time is approximately 11 seconds. The flap control switch is located on the control pedestal. No emergency wing flap actuation system is provided. With flaps extended beyond the **APPROACH** position, the landing gear warning horn will sound, unless the landing gear is down and locked. The flap motor circuit is protected by a 20-ampere circuit breaker, placarded **FLAP MOTOR**, located on the left sidewall circuit breaker panel. The flap system control circuit is protected by a 5-ampere circuit breaker, placarded **FLAP CONTROL**, located on the left sidewall circuit breaker panel.

a. Wing Flap Control Switch. A three-position switch controls flap operation with a flap-shaped handle on the control pedestal. The handle of this switch is placarded **FLAP**. Switch positions are placarded **FLAP / UP / APPROACH / DOWN**. The amount of extension of the flaps is established by the position of the flap switch as follows: **UP** – 0%, **APPROACH** – 40%, and **DOWN** – 100%. Limit switches, mounted on the right inboard flap, establish the flap travel. Intermediate flap positions between **UP** and **APPROACH** cannot be selected. To return the flaps to full **UP**, place the flap switch to the **UP** detent position. To return the flaps to **APPROACH**, move the flap switch to the **UP** position and then to the **APPROACH** detent position. In the event that any two adjacent flap sections extend 3° to 5° out of phase with the other, a safety mechanism is provided to discontinue power to the flap motor.

b. Wing Flap Position Indicator. Flap position in percent of travel from 0% (**UP**) to 100% (**DOWN**) is shown on an indicator, placarded **FLAPS**, located on the center subpanel. The approach and full down flap positions are 14° and 35°, respectively. The flap position indicator is protected by a 5-ampere circuit breaker, placarded **FLAP CONTROL**, located on the left sidewall circuit breaker panel.

Section VI. PROPELLERS

2-41. DESCRIPTION.

A four-blade aluminum propeller is installed on each engine. The propeller is full feathering, constant speed, variable-pitch, counterweighted, and reversible; and is controlled by engine oil pressure through single action, engine driven propeller governors. The propeller is flange mounted to the engine shaft. Centrifugal counterweights, assisted by a feathering spring, move the blades toward the low RPM (high pitch) position and into the feathered position. Governor boosted engine oil pressure moves the propeller to the high RPM (low pitch) hydraulic stop and reverse position. The propeller has no low RPM (high pitch) stops; this allows the blades to feather after engine shutdown. Low pitch propeller position is determined by the low pitch stop, which is a mechanically actuated, hydraulic stop. Ground fine and reverse blade angles are controlled by the **POWER** levers in the ground fine and reverse range.

2-42. FEATHERING PROVISIONS.

Both manual and automatic propeller feathering systems are provided. Manual feathering is accomplished by pulling the corresponding **PROP** lever aft, past a friction detent. To unfeather, the **PROP** lever is pushed forward into the governing range. The automatic feathering system senses loss of torque and feathers an unpowered propeller. Feathering springs feather the propeller when it is not turning.

a. Automatic Feathering. The automatic feathering system provides a means of immediately dumping oil from the propeller servo to enable the feathering spring and counterweights to start feathering the blades in the event of an engine failure. Although the system is armed by a switch on the pilot's subpanel, placarded **AUTOFEATHER ARM / OFF / TEST**, the completion of the arming phase occurs when both **POWER** levers are advanced above 89% N_1. At this time, both annunciators on the caution/advisory annunciator panel indicate a fully armed system. The green annunciators are placarded **L AUTOFEATHER** and **R AUTOFEATHER**. The system will remain inoperative as long as either **POWER** lever is retarded below approximately the 89% N_1 position, unless **TEST** position of the autofeather switch is selected to disable the **POWER** lever limit switches. The system is designed for use only during takeoff or landing, and should be turned off when establishing cruise climb. During takeoff or landing, should the torque for either engine drop to an indication between 21% and 16% **R**, 468 to 356 foot pounds **T3** **F3** , the autofeather system for the opposite engine will be disarmed. Disarming is confirmed when the **AUTOFEATHER** annunciator of the opposite engine becomes extinguished. If torque drops further, to a reading between 14% and 9% **R** , 312 to 200 foot pounds **T3** **F3** , oil is dumped from the servo of the affected propeller, allowing a feathering spring to move the blades into the feathered position. Feathering also causes the **AUTOFEATHER** annunciator of the feathered propeller to extinguish. At this time, both the **L AUTOFEATHER** and **R AUTOFEATHER** annunciators are extinguished, the propeller of the defective engine has feathered, and the propeller of the operative engine has been disarmed from autofeathering capability. Only manual feathering control remains for the second propeller.

b. Propeller AUTOFEATHER ARM / OFF / TEST Switch. A switch, placarded **AUTOFEATHER ARM / OFF / TEST**, located on the pilot's subpanel, is provided for arming and disarming the system and for selection of the **TEST** function. The **TEST** position of the switch checks the readiness of the autofeather system below 89% N_1.

c. Autofeather Annunciators. Autofeather annunciators consist of two green annunciators on the caution/advisory annunciator panel, placarded **L AUTOFEATHER** and **R AUTOFEATHER**. When illuminated, the annunciators indicate that the autofeather system is armed. Both annunciators will be extinguished if either propeller has been feathered or if the system is disarmed by retarding a **POWER** lever. Autofeather circuits are protected by a 5-ampere circuit breaker, placarded **AUTO FEATHER**, located on the right sidewall circuit breaker panel.

2-43. PROPELLER GOVERNORS.

A constant speed governor and an overspeed governor control propeller RPM. The constant speed governor, mounted on top of the reduction housing, controls the propeller through its entire range. The propeller control lever controls the propeller by means of this governor. If the constant speed governor should malfunction and request more than 2000 RPM, the overspeed governor cuts in at 2080 RPM and dumps oil from the propeller to keep the RPM from exceeding approximately 2120 RPM. A solenoid, actuated by the **PROP GOV TEST** switch, located on the pilot's subpanel, is provided for resetting the overspeed governor to approximately 1830 to 1910 RPM for test purposes. If the propeller sticks or moves too slowly during a transient condition, causing the propeller governor to act too slowly to prevent an overspeed condition, the power turbine governor, contained within the constant speed governor housing, acts as a fuel topping governor. When the propeller reaches 106% of selected N_2 RPM, the power turbine governor limits the fuel flow to the gas generator, reducing N_1 RPM, which in turn prevents the propeller from exceeding approximately 2120 RPM. During operation in the reverse range, the power turbine governor is reset to approximately 95% of propeller RPM before the propeller reaches a negative pitch angle. This ensures that engine power is limited, allowing a propeller RPM of somewhat less than that of the constant speed governor setting to be maintained. The constant speed governor, therefore, will always sense an underspeed condition and direct oil pressure to the propeller servo piston to permit propeller operation in beta and reverse ranges.

2-44. LOW PITCH STOP.

Low pitch propeller position is determined by a mechanically monitored hydraulic low pitch stop. The propeller servo piston is connected to the beta collar by four spring-loaded sliding rods mounted behind the propeller. A carbon brush block riding in the beta collar transfers the movement of the collar through the propeller-reversing lever to the beta valve of the governor. The initial forward motion of the beta valve from its rigged position blocks off the flow of oil to the propeller. Further motion dumps the oil from the propeller into the reduction gearbox sump. A mechanical stop limits the forward motion of the beta valve. Rearward movement of the beta valve from its rigged position does not affect normal propeller control. When the propeller is rotating at a speed lower than that selected on the governor, the governor pump provides oil pressure to the servo piston. This decreases the pitch of the propeller blades until the feedback of motion from the beta collar pulls the beta valve into position blocking the supply of oil to the propeller, preventing further pitch changes.

2-45. GROUND IDLE STOP SYSTEM T3 F3.

The ground idle stop system, using an electrical solenoid mounted on the front of the reversing push/pull cable, is designed to operate on the ground only by resetting the propeller blades to maintain an angle below flight idle (from 16° to 10°). The solenoid is connected to the propeller reversing lever by means of a slotted clevis which allows the reversing lever to be pulled aft, resetting the Beta valve.

The electrical solenoid is wired through the right hand landing gear squat switch and quadrant idle sense switch. As the aircraft lands, the squat switch activates the solenoid, which in turn pulls the reverse lever back to reset the Beta valve. This enables the propeller blades to reset automatically to a blade angle lower than the flight idle blade angle increasing propeller RPM. Propeller RPM on the ground is restricted for continuous operation to a minimum of 1150 RPM. Ground operation of the propeller in flight idle blade angle would result in a RPM within the prohibited RPM range. The travel on the reverse lever is limited by the slot in the clevis. While the aircraft is on the ground, the system remains activated. When the squat switch deactivates the solenoid, the spring force from the Beta valve pushes the reverse lever forward to its original position.

2-46. GROUND FINE R.

Lifting the **POWER** levers and moving them aft past the flight idle stop will place the **POWER** levers into the ground fine position. Approximately halfway back to the ground fine gate, a mechanical linkage at the propeller governor will begin to bleed P_y air from the fuel control unit, provided the **PROP** levers are positioned to the **HIGH RPM** position. This results in a decrease in engine N_1, torque, and propeller RPM. With the **POWER** levers at the ground fine gate, engine N_1 should be within the range of 62% to 67%, and propeller RPM should not be less than 1000 RPM.

2-47. PROPELLER SYNCHROPHASER.

a. Description. The propeller synchrophaser matches left and right propeller RPM as well as propeller phase relationship. This phase relationship is designed to decrease cabin noise, and is not adjustable in flight. A toggle switch, placarded **PROP SYN ON** / **OFF**, installed adjacent to the synchroscope on the pilot's instrument panel, turns the system on/off.

Signal pulses occurring once per revolution of the propeller are obtained from magnetic pickups (located in the front of the engine on the deice brush mounting bracket) when the target (mounted on the aft side of the spinner bulkhead) passes the magnetic pickup. The signal pulses are sent to a control box installed forward of the pedestal. The control box receives these signal pulses and compares them for pulse rate and relative position. Differences in pulse rate and/or propeller position cause the control box to vary the voltage in the primary governor coil, which in turn increases propeller speed until the correct speed and phasing are obtained.

A governor coil increases the speed set by the propeller control lever, but never decreases the speed set by the control lever. The maximum synchrophaser range is approximately 20 RPM. This limited range prevents either propeller from losing more than a limited RPM if the other propeller is feathered with the synchrophaser **ON**.

There is a limited range for synchronizing, called the "holding range". There is a maximum RPM differential (capture range), at which the synchrophaser, when turned on, will begin to synchronize the propellers. For this reason the propellers should be manually synchronized before turning the synchrophaser on.

NOTE

If the synchrophaser is ON but does not adjust properly, the synchrophaser has reached the limit of its range. Turn the system OFF, manually adjust the propeller RPM into synchronization, then turn the synchrophaser ON.

The propeller synchrophaser may be used during takeoff at the pilot's option.

b. Synchrophaser Control Box. The control box, located forward of the pedestal, converts pulse rate differences into correction commands. Differences in pulse rate, and/or propeller position, cause the control box to vary the voltage in the primary governor coil, which in turn increases propeller speed until the correct speed and phasing are obtained. The system is protected by a 5-ampere circuit breaker, placarded **PROP SYNC**, located on the right sidewall circuit breaker panel, refer to Figure 2-6.

c. Synchroscope. The propeller synchroscope, located on the pilot's instrument panel, provides an indication of synchronization of the propellers. If the right propeller is operating at a higher RPM than the left, a black and white cross pattern spins in a clockwise direction. Counterclockwise rotation indicates a higher RPM of the left propeller. This instrument aids the pilot in obtaining complete synchronization of the propellers.

2-48. PROPELLER LEVERS.

Two propeller levers on the control pedestal, placarded **PROP**, are used to regulate propeller speeds. Each lever controls a primary governor to regulate propeller speeds within the normal operational range. The full forward position of the levers is placarded **TAKEOFF / LANDING / REVERSE / HIGH RPM.** The full aft position of the levers is placarded **FEATHER**. When a lever is placed at **HIGH RPM**, the propeller may attain a static RPM of 1700 depending upon power lever position. As a lever is moved aft, passing through the propeller governing range but stopping at the feathering detent, the propeller RPM will correspondingly decrease to the lowest limit (approximately 1200 RPM). Moving a **PROP** lever aft past the detent into **FEATHER** will feather the propeller.

2-49. PROPELLER REVERSING.

CAUTION

Do not move the power levers below the flight idle gate unless the engine is running. Damage to the reverse linkage mechanisms will occur.

Propeller reversing on unimproved surfaces should be accomplished carefully to prevent propeller erosion from reversed airflow. Consideration should be given to not reversing propellers when operating in snow or dusty conditions, to prevent obscuring the pilot's vision.

The engine **POWER** levers actuate an engine-mounted cambox that is connected to the engine Fuel Control Unit (FCU) and the propeller reversing cable. The cambox is arranged so that **POWER** lever movement forward of the idle stop does not affect the reversing cable. When the **POWER** levers are lifted over the reversing detent and moved rearward, the reversing cable is pulled aft. This action resets the beta valve rearward, allowing the governor to pump more oil into the propeller, thus moving the blades through the ground fine range toward reverse pitch. As the blades move, the mechanical feedback collar is moved forward. This movement is transmitted by a carbon block on the end of the reversing lever to the beta valve, causing it to move forward. As the **POWER** levers are moved further rearward (into the striped area), the propeller blades are moved further toward the reverse pitch stop, and the FCU is reset to increase engine speed.

2-50. PROPELLER TACHOMETERS.

a. Propeller Tachometer R F3. Two tachometers on the instrument panel register propeller speed in hundreds of RPM. Each indicator is slaved to a tachometer-generator unit attached to the corresponding engine, installed on the reduction gearbox.

b. Propeller Tachometer T3 . The indicator shall display the measured N_2 concurrently in a 1 alphabetic, 3 ½-numeric character digital display, and a 38-segment bar graph display. The indicator has a digital display range of 0 to 2500 RPM while displaying current N_2 and 0 to 4000 RPM while displaying exceedence N_2. The bar graph display has a range of 0 to 2500 RPM.

The digital display will contain dashes (------) when the measured N_2 is greater than 2500 RPM. When displaying exceedence N_2 values, the actual measured value, not "-----", will be displayed up to 4000 RPM. The dashes will be prefixed with an **F** if an EEPROM failure has been detected and with an **E** if an event has been stored and not played back.

The indicator performs BIT on the LCD display, ROM (program memory), RAM (volatile data memory), EEPROM (non-volatile data memory), and input signal. The display BIT shall consist of displaying all active LCD segments for 3 seconds on powerup. If the ROM or RAM fails BIT the indicator display will be blank. If the input signal fails BIT the indicator will display 0 on both the digital and bar graph displays. If the EEPROM fails BIT the indicator will prefix the digital display with an **F**. BIT failures are not stored in EEPROM. Failures detected shall therefore not affect the display after power is cycled unless the failure is encountered again.

Each exceedence event will consist of two 16-bit words. One word will contain the peak RPM measured during the event and the other word contains the event duration in seconds. A maximum of 50 events can be recorded. If more than 50 events are recorded, only 50 will be stored. As new events are recorded, the oldest events will be discarded. The indicator will prefix the digital display with an **E** when an event is being or has been recorded and not played back.

The indicator will start recording an event immediately when the indicator has measured RPM greater than 2200 or when the indicator has measured RPM above 2081 continuously for five seconds. The indicator display will start flashing whenever the measured RPM exceeds 2081. The flashing will cease and digital display will be prefixed with an **E** when the indicator begins recording an exceedence. The indicator will end exceedence recording and store the event when the measured RPM drops to 2080 or lower.

NOTE

Pressing the EXCEEDENCE ERASE switch for 0.2 seconds or longer will cause all events to be erased from non-volatile memory. There are no provisions for erasing individual events.

The event display takes precedence over normal digital display. The bar graph will continue to display current N_2 data. To activate the event display, press the **EXCEEDENCE DISPLAY** switch for 0.2 seconds or longer. The most recent event will be displayed first. Each event display contains the following cycle:

1. The event number will be displayed for 2 seconds.

2. The event peak RPM will be displayed for 2 seconds.

3. The event duration in seconds will be displayed for 2 seconds.

All three data items displayed during playback will be prefixed with a **P** unless an EEPROM BIT failure has been detected in which case the display will be prefixed with an **F**.

The event display will be terminated after all of the recorded events have been displayed. Once the playback sequence has been performed the **E** prefixed to the digital display will be removed. All event data is still available for playback until the data is erased. The display will be prefixed with an **E** again on the next power up cycle if the old data has not been erased or if another event is recorded.

Section VII. UTILITY SYSTEMS

2-51. DEFROSTING SYSTEM.

a. Description. The defrosting system is an integral part of the heating and ventilation system. The system consists of two warm air outlets connected by ducts to the heating system. One outlet is just below the pilot's windshield and the other is just below the copilot's windshield. A push-pull control, placarded **DEFROST AIR**, on the pilot's subpanel, manually controls airflow to the windshield. When the control is pulled out, defrosting air is ducted to the windshield. As the control is pushed in, there is a corresponding decrease in airflow.

b. Automatic Operation.

1. **VENT BLOWER** Switches – As required.

2. **CABIN TEMP MODE** Switch **– AUTO**.

3. **CABIN TEMP** Rheostat – As required.

4. **CABIN AIR, COPILOT AIR, PILOT AIR**, and **DEFROST AIR** Controls – As required.

c. Manual Operation. If the automatic temperature control should fail to operate, the temperature of defrost air and cabin air can be controlled manually by setting the **CABIN TEMP MODE** switch to the **MAN HEAT** position, then using the **MANUAL TEMP** switch to set the desired temperature. This control is located on the copilot's subpanel. Use the following procedure for manual operation:

1. **PILOT** and **COPILOT AIR** Controls – In.
2. **CABIN AIR** and **DEFROST AIR** Controls – Out.
3. **CABIN TEMP MODE** Switch – **MAN HEAT**.
4. Cold Air Outlets – As required.
5. **MANUAL TEMP** Switch – As required.

2-52. SURFACE DEICING SYSTEM.

a. Description. Ice accumulation is removed from each inboard and outboard wing leading edge and both horizontal stabilizers by the flexing of deice boots that are pneumatically actuated. Bleed air is used to supply air pressure to inflate the deice boots and to supply vacuum through the ejector system. A pressure regulator protects the system from over inflation. When the system is not in operation, a distributor valve keeps the boots held down by vacuum supplied through the ejector system.

CAUTION

Operation of the surface deice system in ambient temperatures below –40 °C can cause permanent damage to the deice boots.

NOTE

Under conditions where one bleed air source is inoperative, sufficient bleed air pressure for deice boot inflation may not be available. Prior to deice boot inflation, check the regulated bleed air pressure gauge for a minimum of 16 psi. If insufficient pressure exists, increasing engine N_1 and/or decreasing aircraft altitude will increase bleed air pressure.

b. Operation.

(1) Deice Boots. Deice boots are intended to remove ice after it has formed rather than prevent ice formation. For the most effective deicing operation, allow at least 1/2 inch of ice to form on the boots before attempting ice removal. Very thin ice may crack and cling to the boots instead of shedding.

WARNING

Never cycle the system rapidly. This may cause the ice to accumulate outside the contour of the inflated boots and prevent ice removal.

(2) Deice Switch. A two position deice switch, placarded **DEICE CYCL**, on the pilot's subpanel, controls the deicing operation. The switch is spring loaded to return to the off position from **SINGLE** or **MANUAL**.

(a) ***SINGLE*** *Position*. When the **SINGLE** position is selected, the distributor valve opens to inflate the wing boots. After an inflation period of approximately 6 seconds, an electronic timer switches the distributor to deflate the wing boots and a 4-second inflation begins in the horizontal stabilizer. When these boots have inflated and deflated, the cycle is complete.

(b) ***MANUAL*** *Position*. If the switch is held in the **MANUAL** position, the boots will inflate simultaneously and remain inflated until the switch is released. The switch will return to the **OFF** position when released. After the cycle, the boots will remain in the vacuum hold down condition until again actuated by the switch.

(3) Bleed Air. Either engine is capable of providing sufficient bleed air for all requirements of the surface deice system. Check valves in the bleed air and vacuum lines prevent backflow through the system during single engine operation. Regulated pressure is indicated on a gauge, placarded **PNEUMATIC PRESSURE**, located on the copilot's subpanel.

2-53. PROPELLER ELECTRIC DEICE SYSTEM.

a. Description. The propeller electric deice system includes electrically heated deice boots, slip rings and brush block assemblies, a timer for automatic operation, ammeter, circuit breakers for left and right propeller and control circuit protection, and two switches located on the pilot's subpanel, for automatic or manual control of the system.

b. Automatic Operation. The two-position switch located on the pilot's subpanel, placarded **PROP AUTO / OFF**, is provided to activate the automatic system. When the switch is placed to the **AUTO** position, the timer diverts power through the brush block and slip ring to all heating elements on one propeller. Subsequently, the timer then diverts power to all heating elements on the other propeller for the same length of time. This cycle will continue as long as the switch is in the **AUTO** position. The system utilizes a metal-foil type, single heating element, energized by dc voltage. The timer switches every 90 seconds, resulting in a complete cycle in approximately 3 minutes.

c. Manual Operation. The manual propeller deice system is provided as a backup to the automatic system. The spring-loaded control switch located on the pilot's subpanel, placarded **PROP MANUAL / OFF**, controls the manual override relay. When the switch is held in the **MANUAL** position, the automatic timer is overridden, and power is supplied to the heating elements of both propellers simultaneously. The switch is of the momentary type and must be held in position for approximately 90 seconds to dislodge ice from the propeller surface. Repeat this procedure as required to avoid significant buildup of ice, which will result in a loss of performance, vibration, and impingement of ice upon the fuselage. The propeller deice ammeter will not indicate a load while the propeller deice system is being utilized in the manual mode. However, each aircraft loadmeter will indicate an approximate 10% increase in load while the manual propeller deice system is operating.

2-54. PITOT HEAT SYSTEM.

CAUTION

Pitot heat should not be used for more than 15 minutes while the aircraft is on the ground. Overheating may damage the heating elements.

Heating elements are installed in both pitot masts, located on the nose. Each heating element is controlled by an individual 7 ½-ampere circuit breaker switch, placarded **PITOT**, **LEFT** and **RIGHT**, located on the pilot's subpanel.

2-55. STALL WARNING HEAT SYSTEM.

CAUTION

Heating elements protect the stall warning lift transducer vane and faceplate from ice. However, a buildup of ice on the wing may change or disrupt the airflow and prevent the system from accurately indicating an imminent stall.

The lift transducer is equipped with anti-icing capability on both the mounting plate and the vane. Stall warning vane heat is controlled by, and the circuit is protected by, a 15-ampere circuit breaker switch located on the pilot's subpanel, placarded **STALL WARN**. The level of heat is minimal for ground operation, but is automatically increased for flight operation through the landing gear safety switch.

2-56. STALL WARNING SYSTEM.

The stall warning system consists of a transducer, a lift computer, warning horn, and a test switch. Angle of attack is sensed by aerodynamic pressure on the lift transducer vane located on the left wing leading edge. When a stall is imminent, the output of the transducer activates a stall warning horn. The system has preflight test capability through the use of a switch, placarded **STALL WARN TEST**, located on the copilot's subpanel. Holding this switch in the **STALL WARN TEST** position actuates the warning horn by moving the transducer vane. The circuit is protected by a 5-ampere circuit breaker, placarded **STALL WARN**, located on the right sidewall circuit breaker panel.

2-57. BRAKE DEICE SYSTEM.

a. Description. The brake deice system may be used in flight with gear retracted or extended, or on the ground. When the brake deice system is activated, hot air is diffused by means of a manifold assembly over the brake discs on each wheel. Manual and automatic controls are provided. There are two primary occasions that require brake deicing. The first is when an aircraft has been parked in a freezing atmosphere, allowing the brake systems to become contaminated by freezing rain, snow, or ice, and the aircraft must be moved or taxied. The second occasion is during flight through icing conditions, when brake assemblies are presumed to be frozen must be thawed prior to landing to avoid possible tire damage and loss of directional control. Hot air for the brake deice system comes from the compressor stage of both engines. Hot air is obtained by means of a solenoid valve attached to the bleed air system which serves both the surface deice system and the pneumatic systems operation.

b. Operation. A switch, placarded **BRAKE DEICE**, located on the pilot's subpanel controls the solenoid valve by routing power through a control module box under the aisle floorboards. A 5-ampere circuit breaker, placarded **BRAKE DEICE**, located on the right sidewall circuit breaker panel protects the system. A timer limits operation to approximately 10 minutes to avoid excessive wheel well temperatures when the landing gear is retracted. The control module also contains a circuit to the green **BRAKE DEICE ON** annunciator, and has a resetting circuit interlocked with the gear uplock switch. When the system is activated, the **BRAKE DEICE ON** annunciator should be monitored and the control switch selected **OFF** after the annunciator extinguishes, otherwise, on the next gear extension, the system will restart without pilot action. The control switch should also be selected **OFF** if deice operation fails to self-terminate after approximately 10 minutes. If the automatic timer has terminated brake deice operation after the last retraction of the landing gear, the landing gear must be extended in order to obtain further operation of the system.

NOTE

The BL AIR FAIL annunciator lights may illuminate momentarily during simultaneous operation of the surface and brake deice systems at low N_1 speed. If lights extinguish immediately they may be disregarded.

(1) During certain ambient conditions, use of the brake deice system may reduce available engine power, and during flight will result in an ITT rise of approximately 20 °C. Applicable performance charts should be consulted before brake deice system use. If specified power cannot be obtained without exceeding limits, the brake deice system must be selected **OFF** until after takeoff is completed. ITT limitations must also be observed when setting climb and cruise power. The brake deice system is not to be operated above 15 °C ambient temperature. During periods of simultaneous brake deice and surface deice operation, maintain 85% N_1 or higher. If inadequate pneumatic pressure is developed for proper surface deice boot inflation, select the brake deice system **OFF**. Both sources of pneumatic bleed air must be in operation during brake deice system use. Select the brake deice system **OFF** during single engine operation.

2-58. FUEL SYSTEM ANTI-ICING.

a. Description. An oil-to-fuel heat exchanger, located in each engine accessory case, operates continuously and automatically to heat the fuel sufficiently to prevent freezing of any water in the fuel. No controls are involved. Three external fuel vents are provided on each wing. One is recessed to prevent ice formation, the second is flush mounted so that no ice can collect upon it, and the third is electrically heated. Heating is controlled by two toggle switches, placarded **FUEL VENT LEFT** and **RIGHT**, located on the pilot's subpanel. They are protected by two 5-ampere circuit breakers, placarded **FUEL VENT LEFT** and **RIGHT**, located on the right sidewall circuit breaker panel.

CAUTION

To prevent overheat damage to electrically heated anti-ice jackets, the FUEL VENT heat switches should not be turned on unless cooling air will soon pass over the jackets.

b. Normal Operation. For normal operation, switches for the fuel vent anti-ice circuits are turned on as required during the BEFORE TAKEOFF procedures.

2-59. WINDSHIELD ELECTROTHERMAL ANTI-ICE SYSTEM.

a. Description. Both the pilot's and copilot's windshields are provided with an electrothermal anti-ice system. Each windshield is part of an independent electrothermal anti-ice system. Each system is comprised of the windshield assembly with heating wires sandwiched between glass panels, a temperature sensor attached to the glass, an electrothermal controller, two relays, a control switch, and two circuit breakers. Two switches, placarded **WSHLD ANTI-ICE PILOT NORMAL / OFF / HIGH**, and **WSHLD ANTI-ICE COPILOT**, **NORMAL / OFF / HIGH**, located on the pilot's subpanel, control system operation. Each switch controls one electrothermal windshield system. A 5-ampere circuit breaker and a 50-ampere circuit breaker, which are not accessible to the flight crew, protect the circuits of each system.

CAUTION

To help prevent windshield cracking, windshield heat should be placed in the NORMAL position for at least 15 minutes prior to using the HIGH position.

b. Normal Operation. Two levels of heat are provided through the three position switches, placarded **NORMAL** in the up position, **OFF** in the center position, and **HIGH** after pulling the switch over a detent and moving it to the down position. In the

NORMAL position, heat is provided for the major portion of each windshield. In the **HIGH** position, heat is provided at a higher watt density to a smaller portion of the windshield. The lever lock switch feature prevents inadvertent switching to the **HIGH** position during system shutdown.

2-60. PRESSURIZATION SYSTEM.

a. Description. A mixture of engine bleed air and ambient air is available for cabin pressurization at a rate of approximately 10 to 17 pounds per minute. The flow control unit of each engine controls bleed air from the engine to make it usable for pressurization, by mixing ambient air with the bleed air, depending upon aircraft altitude and ambient temperature. On takeoff, excessive pressure bumps are prevented by landing gear safety switch actuated solenoids incorporated in the flow control units. These solenoids, through a time delay, stage the input of ambient air flow by allowing ambient air flow introduction through the left flow control unit first, then 4 seconds later allowing ambient air flow through the right flow control unit.

b. Pressure Differential. The pressure vessel is designed for a normal working pressure differential of 6.5 psi, which will provide a cabin pressure altitude of 8,000 feet at an aircraft altitude of 29,700 feet, and a cabin pressure altitude of 10,000 feet at an aircraft altitude of 34,000 feet.

c. Pressurization Controller. The pressurization controller, located on the pedestal extension, provides a display of the selected altitude, an altitude selector, and a rate control selector. The cabin and aircraft altitude display is a mechanically coupled dial. The outer scale, **CABIN ALT** of the display, indicates the selected cabin altitude. The inner scale, **ACFT ALT** indicates the corresponding altitude at which the maximum differential pressure would occur. The indicated value on each scale is read as placarded, **ALT – FT X 1000**. The rate control selector, placarded **RATE INC**, regulates the rate at which cabin pressure ascends or descends to the selected altitude. The rate change selected may be from 200 to 2000 feet per minute.

d. Cabin Rate-of-Climb Indicator. An indicator, placarded **CABIN CLIMB**, is located on the center subpanel. It is calibrated in thousands of feet per minute change in cabin altitude.

e. Cabin Altitude Indicator. An indicator, placarded **CABIN ALT**, is located on the center subpanel. The longer needle indicates aircraft altitude in thousands of feet on the outside dial. The shorter needle indicates pressure differential in psi on the inner dial. Maximum differential is 6.5 ± .10 psi.

f. Outflow Valve. A pneumatically operated outflow valve, located in the aft pressure bulkhead, maintains the selected cabin altitude and rate-of-climb commanded by the cabin rate-of-climb and altitude controller. As the aircraft climbs, the controller modulates the outflow valve to maintain a selected cabin rate of climb and increases the cabin differential pressure until the maximum cabin pressure differential is reached. At a cabin altitude of 12,500 feet, a pressure switch mounted on the back of the overhead control panel completes a circuit to illuminate a red **ALT WARN** warning annunciator, to warn of operation requiring oxygen.

g. Safety Valve. Before takeoff, the safety valve is open with equal pressure between the cabin and the outside air. The safety valve closes upon lift off if the switch, placarded **CABIN PRESS DUMP** / **PRESS** / **TEST**, located on the pedestal extension, is in the **PRESS** mode. The safety valve, adjacent to the outflow valve, provides pressure relief in the event of an outflow valve failure. The safety valve is also used as a dump valve. The safety valve is opened by vacuum, which is controlled by a solenoid valve operated by the **CABIN PRESS** switch. It is wired through the right landing gear safety switch. If either of these switches is open, or if the vacuum source or electrical power is lost, the safety valve will close to atmosphere except at maximum pressure differential of 6.5 ±.10 psi. A negative pressure relief diaphragm is also incorporated into the outflow and safety valves to prevent outside atmospheric pressure from exceeding cabin pressure during rapid descent

h. Drain. A drain in the outflow valve static control line is provided for removal of accumulated moisture. The drain is located behind the lower sidewall upholstery access panel in the baggage section of the aft compartment.

i. Flow Control Unit. A flow control unit, located forward of the firewall in each engine nacelle, controls bleed air flow and the mixing of ambient air to make up the total air flow to the cabin for pressurization, heating, and ventilation. The **BLEED AIR VALVES** switches on the copilot's subpanel control an integral electric solenoid firewall shutoff valve. A solenoid, operated by the right landing gear safety switch, controls the introduction of ambient air to the cabin upon takeoff. Both the ambient airflow control valve and the bleed airflow control valve are motor driven.

The unit receives bleed air from the engine into an ejector that draws ambient air into the venturi of the nozzle. The mixed air is then forced into the bleed airline routed to the cabin.

Bleed airflow is controlled automatically. When the aircraft is on the ground, circuitry from the landing gear safety switch prevents ambient air from entering the flow control unit to provide maximum heating.

The bleed air firewall shutoff valve in the control unit is a spring-loaded bellows-operated valve that is held in the open position by bleed air pressure. When the electric solenoid is shut off, or when bleed air diminishes on engine shutdown (in both cases the pressure to the firewall shutoff valve is cut off), the firewall valve closes.

2-61. OXYGEN SYSTEM.

a. Description. The oxygen system, Figure 2-24, is provided primarily as an emergency system; however, the system may also be used to provide supplemental (first aid) oxygen. One 77 cubic-foot capacity oxygen supply cylinder, charged with aviator's breathing oxygen, is installed in the unpressurized portion of the aircraft behind the aft pressure bulkhead. The pilot's and copilot's positions are equipped with mask mounted diluter demand/100% regulators, which automatically mix the proper amount of oxygen for a given amount of air at altitude. Drop out masks are provided for passengers. A first aid oxygen mask is also provided in the cabin. A gauge, placarded **OXYGEN**, located on the copilot's subpanel displays oxygen supply pressure. Oxygen system refilling is accomplished through a single filler valve located on the aft right side of the fuselage exterior. The oxygen system control circuit is protected by a 5-ampere circuit breaker placarded **OXYGEN CONTROL**, located on the right sidewall circuit breaker panel. Table 2-5 shows oxygen flow planning rates vs altitude. Table 2-6 shows oxygen duration capacities of the system in liters per minute (LPM) per mask at normal temperature and pressure, dry (NTPD). Figure 2-25 provides a graph that depicts oxygen cylinder capacity.

b. Oxygen System Operation. A push/pull oxygen on/off control handle, located on the left side of the control pedestal (R models) and overhead (F3/T3), arms the automatically deployed passenger oxygen system and applies oxygen pressure to the crew masks. Pulling this handle out opens a valve on the oxygen cylinder that is located aft of the aft pressure bulkhead. When this handle is pushed in, no oxygen will be available anywhere in the aircraft. To ensure oxygen availability, the oxygen on/off control handle should be pulled and the **OXYGEN** pressure gauge, located on the copilot's subpanel, should be checked prior to engine start.

c. Oxygen Duration. The oxygen system is based on an adequate oxygen flow for a pressure altitude of 35,000 feet. The passenger masks and oxygen duration chart, Table 2-6, is based on a flow rate of 3.9 liters per minute – normal temperature and pressure, dry (LPM-NTPD). For oxygen duration computation, each diluter demand mask being used is counted as two masks at 3.9 LPM-NTPD.

d. Pilot and Copilot Oxygen Masks. The pilot and copilot are each provided with a diluter-demand quick donning oxygen mask stored in the cockpit. The crew masks are stowed with the oxygen hose plugged in so that oxygen will be immediately available when required. This does not cause a loss of oxygen since the diluter demand masks will deliver oxygen only upon inhalation.

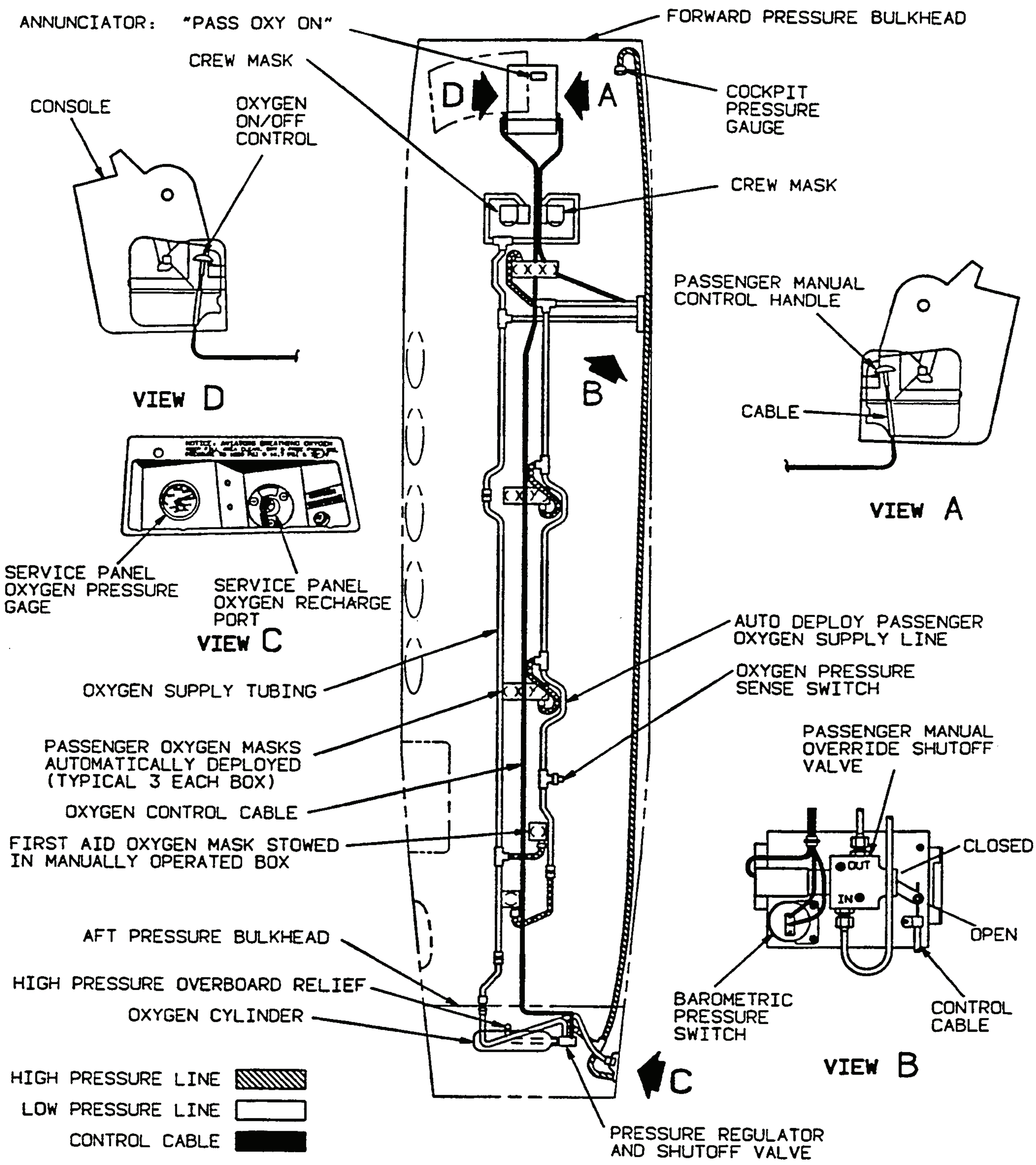


Figure 2-24. Oxygen System

Table 2-5. Oxygen Flow Planning Rates Vs Altitude (All Flows in LPM Per Mask at NTPD)

CABIN PRESSURE ALTITUDE IN FEET	CREW MASK NORMAL (DILUTER DEMAND) (1)	CREW MASK 100% (1)	PASSENGER MASK
35,000	-0-(2)	3.1	3.7 (3)
34,000	-0-(2)	3.4	3.7 (3)
33,000	-0-(2)	3.7	3.7 (3)
32,000	-0-(2)	3.9	3.7 (3)
31,000	-0-(2)	4.2	3.7 (3)
30,000	-0-(2)	4.4	3.7 (3)
29,000	-0-(2)	4.7	3.7 (3)
28,000	-0-(2)	5.0	3.7 (3)
27,000	-0-(2)	5.3	3.7 (3)
26,000	-0-(2)	5.6	3.7 (3)
25,000	-0-(2)	5.9	3.7
24,000	-0-(2)	6.2	3.7
23,000	-0-(2)	6.6	3.7
22,000	-0-(2)	6-9	3.7
21,000	-0-(2)	7.2	3.7
20,000	3.6	7.6	3.7
19,000	3.9	7.9	3.7
18,000	4.2	8.3	3.7
17,000	4.5	8.7	3.7
16,000	4.8	9.1	3.7
15,000	5.1	9.5	3.7
14,000	5.4	10.0	3.7
13,000	5.8	10.4	3.7
12,000	6.1	10.9	3.7
11,000	6.5	11.3	3.7
10,000	6.9	11.9	3.7

NOTES:

(1) Based on minute volume of 20 LPM-BTPS (Body Temperature and Pressure Saturated).
(2) Use 100% oxygen above 20,000 feet.
(3) Not recommended for other than emergency descent use above 25,000 feet.

If average climb or descent flows are desired, add the values between altitudes and divide by the number of values used. For example, to determine the average rate for a uniform descent between 25,000 feet and 15,000 feet perform the following:

(5.9 + 6.2 + 6.6 + 6.9 + 7.2 + 7.6 + 3.9 + 4.2 + 4.5 + 4.8 + 5.1) ÷ 11 = 5.7 LPM.
This method is preferred over averaging the extremes as some flow characteristics vary in such a way as to yield an incorrect answer.

Table 2-6. Oxygen Duration in Minutes

OXYGEN DURATION WITH FULL BOTTLE (100% CAPACITY)									
STATED CYLINDER SIZE (CU FT)	* NUMBER OF PEOPLE USING								
	1	2	3	4	5	6	7	8	9
	DURATION IN MINUTES								
77	488	244	182	122	97	81	69	61	54
STATED CYLINDER SIZE (CU FT)	* NUMBER OF PEOPLE USING								
	10	11	12	13	14	15	*16	*17	
	DURATION IN MINUTES								
77	48	44	40	37	34	32	30	28	

* For oxygen duration computations, count each diluter-demand crew mask in use as two (e.g., with four passengers and a crew of two, enter the table at eight people using).

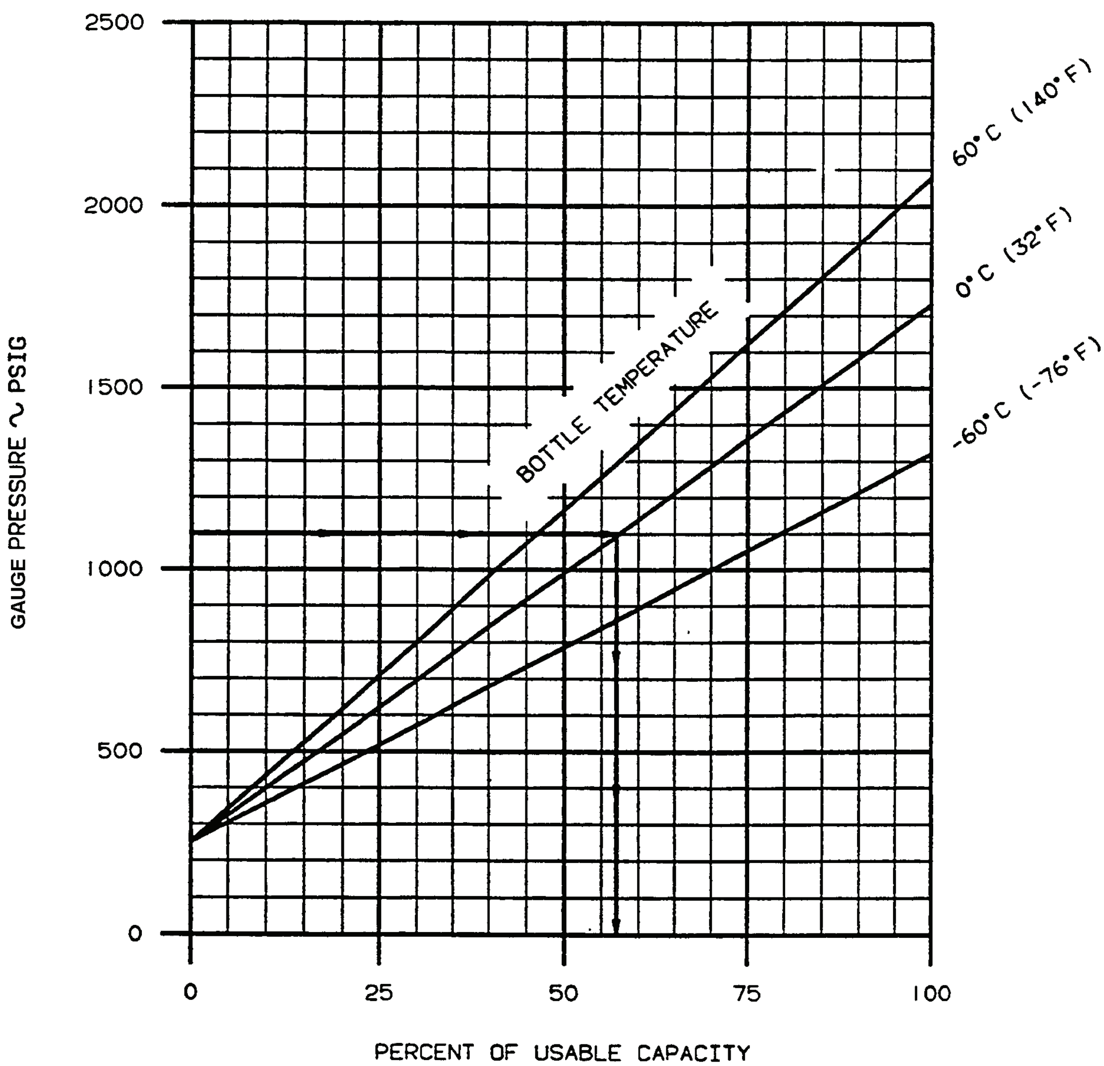


Figure 2-25. Oxygen Cylinder Capacity

(1) Use Of Pilot and Copilot Oxygen Masks. To don the mask, grasp the red levers protruding from the stowage compartment and pull the mask down/ forward. Inflate the mask harness by pressing the red lever on the left side of the regulator and then don the mask and release the lever. Three modes of operation are available which are controlled by a selector lever located on the bottom right side of the regulator:

(a) ***NORMAL*** *Mode*. When the selector lever is placed in the **NORMAL** position, oxygen is automatically mixed with the proper amount of air at the aircraft's altitude. The **NORMAL** mode may be selected at the discretion of the user at any altitude.

(b) ***100%*** *Mode*. When the selector lever is placed in the **100%** position, pure undiluted oxygen is supplied to the mask. The **100%** mode may be selected at the discretion of the user at any altitude.

*(c) Emergency (**EMERG**) Mode*. Turning the **EMERG** knob, located on the bottom of the regulator, places the mask in the emergency mode. In the **EMERG**, mode the regulator will supply 100**%** undiluted oxygen to the user under a positive pressure to the facemask. The emergency mode should be used if smoke or fumes are present in the aircraft. The emergency mode may be selected at the discretion of the user at any altitude.

e. Passenger Oxygen System. The passenger oxygen system is of the constant flow type. Anytime the cabin pressure altitude exceeds approximately 12,500 feet, a barometric pressure switch automatically energizes a solenoid which opens the passenger oxygen system shut-off valve. The pilot or copilot can open the valve manually anytime by pulling out the passenger oxygen, manual-control handle, located on the right side of the pedestal or overhead. Once the passenger oxygen system shut-off valve has been opened, either automatically or manually, oxygen will flow into the passenger oxygen supply line if the primary oxygen system line has been charged. That is, if the oxygen supply cylinder contains oxygen and the **PULL ON SYS READY** handle in the cockpit is pulled out. When the passenger oxygen supply line is charged, the green **PASS OXY ON** annunciator on the caution/advisory annunciator panel will illuminate. The cabin lights, foyer light, and the center baggage compartment light will be illuminated in the full bright mode regardless of the position of the cabin lights switch, placarded **CABIN BRIGHT** / **DIM** / **OFF**, located on the copilot's subpanel. Oxygen pressure in the passenger line causes the passenger oxygen masks to drop out of the overhead mask compartments. The lanyard on the mask must then be pulled out in order to start the flow of oxygen.

NOTE

The lanyard valve pin must be manually reinserted into the valve to stop the flow of oxygen when the mask is no longer needed.

The passenger oxygen can be shut off and the remaining oxygen isolated to the crew and first aid outlets by pulling the **OXYGEN CONTROL** circuit breaker, located on the right sidewall circuit breaker panel, providing the **PASSENGER MANUAL O RIDE** handle is pushed in to the **OFF** position.

f. First Aid Oxygen Mask. A first aid oxygen mask is installed in the aft cabin area as a supplemental or emergency source of oxygen. Anytime the primary oxygen supply line is charged, oxygen can be obtained from the first aid oxygen mask located in the toilet area, by manually opening the overhead access door, placarded **FIRST AID OXYGEN – PULL,** and opening the **ON** – **OFF** valve inside the box. A placard which reads, **NOTE: CREW SYS MUST BE ON,** reminds the user that the **PULL ON SYS READY** handle in the cockpit must be pulled out before oxygen will flow from the first aid oxygen mask.

2-62. WINDSHIELD WIPERS.

a. Description. Two electrically operated windshield wipers are provided for use at all flight speeds. A rotary switch, placarded **WINDSHIELD WIPERS**, located on the overhead control panel, selects mode of windshield wiper operation. An information placard above the switch states, **DO NOT OPERATE ON DRY GLASS**. Function positions of the switch, as read clockwise, are placarded: **PARK / OFF / SLOW / FAST**. When the switch is held in the spring-loaded **PARK** setting, the blades will return to their normal inoperative position on the glass, then, when released, the switch will return to the **OFF** position, terminating windshield wiper operation. The **FAST** and **SLOW** switch positions are separate operating speed settings for wiper operation. The windshield wiper circuit is protected by one 10-ampere circuit breaker, placarded **WSHLD WIPER**, located on the right sidewall circuit breaker panel.

CAUTION

Do not operate windshield wipers on dry glass. Such action can damage the linkage as well as scratch the windshield glass.

b. Normal Operation. To start, turn **WINDSHIELD WIPER** switch to **FAST** or **SLOW** speed, as desired. To stop, turn the switch to the **PARK** position and release. The blades will return to their normal inoperative position and stop. Turning the switch only to the **OFF** position will stop the windshield wipers, without returning them to the normal inactive position.

2-63. CHEMICAL TOILET.

a. Description. A side-facing chemical toilet, which can also be used as an additional seat, is installed in the aft cabin area. Two hinged-lid half-sections must be raised to gain access to the toilet. Waste is stored within a removable container located below the seat in the cabinet assembly. This non-flushing system uses a dry chemical preparation to deodorize the stored waste. A toilet tissue dispenser is contained in a slide-out compartment on the forward side of the toilet cabinet assembly. A box of disposable waste container liners and a box of chemical deodorant packets are also stored in the cabinet.

b. Operation. During use, a removable throwaway plastic liner is attached to the waste container. After use, dry chemical deodorant obtained from the storage cabinet is deposited on the waste and the hinged lid sections are closed over the cavity. After each flight, the waste container must be removed, emptied, relined, and replaced in the cabinet. Consumable toilet items should be re-supplied as needed.

2-64. ELECTRICAL TOILET T3 F3.

A side-facing toilet is located opposite the airstair door. A curtain is provided which, when extended across the passenger compartment, separates the toilet area. The seat may also be used as a passenger seat.

The toilet is a re-circulating electric flush type. Normal servicing is within 2-1/2 gallons of fluid, which provides for approximately 15 uses. When the container is removed for servicing, it is sealed. Chemical is mixed with water in a ratio of 3 ounces to 2 quarts of water.

Power for the electric flush motor is provided through either the **FURN ON** or **COFFEE OFF** positions of the furnishings switch located on the copilot's inboard side panel.

Also located in a storage area along the fuselage wall is a relief tube. A lever type handle is incorporated which, when pressed, allows suction from outside air to draw waste overboard through the relief tube drain.

2-65. SUN VISORS.

CAUTION

When adjusting the sun visors, grasp only by the top metal attachment to avoid damage to the plastic shield.

Individual sun visors are provided for the pilot and copilot. Each visor is manually adjustable. When not needed as a sun shield, each visor may be rotated to a position flush with the top of the cockpit so that it does not obstruct view through the windows.

Section VIII. HEATING, VENTILATION, COOLING, AND ENVIRONMENTAL CONTROL SYSTEM

2-66. HEATING SYSTEM.

Warm air for heating the cockpit and cabin and for defrosting the windshield is provided by bleed air from both engines. Engine bleed air is combined with ambient air in the heating and pressurization flow control unit in each engine nacelle. If the mixed bleed air is too warm for cockpit comfort, it is cooled by being routed through an air-to-air heat exchanger located in the forward portion of each inboard wing. If the mixed bleed air is not too warm, the air-to-air heat exchangers are bypassed. The mixed bleed air is then ducted to a mixing plenum, where it is mixed with cabin re-circulated air. The warm air is then ducted to the cockpit outlets, windshield defroster outlets, and floor outlets in the cabin compartment. The environmental system is shown in Figure 2-26.

a. Bleed Air Flow Control Unit. A bleed air flow control unit, located forward of the firewall in each engine nacelle, controls the flow of bleed air and the mixing of ambient air to make up the total airflow to the cabin for heating, windshield defrosting, pressurization, and ventilation. The unit is electronically controlled with an integral electric solenoid firewall shutoff valve, controlled by the **BLEED AIR VALVES** switches located on the copilot's subpanel, and a normally open solenoid valve operated by the right landing gear safety switch.

b. Pneumatic Bleed Air Shutoff Valve. A pneumatic shutoff valve is provided in each engine nacelle to control the flow of bleed air to the surface and brake deice systems. The **BLEED AIR VALVES** switches, located on the copilot's subpanel, control these valves.

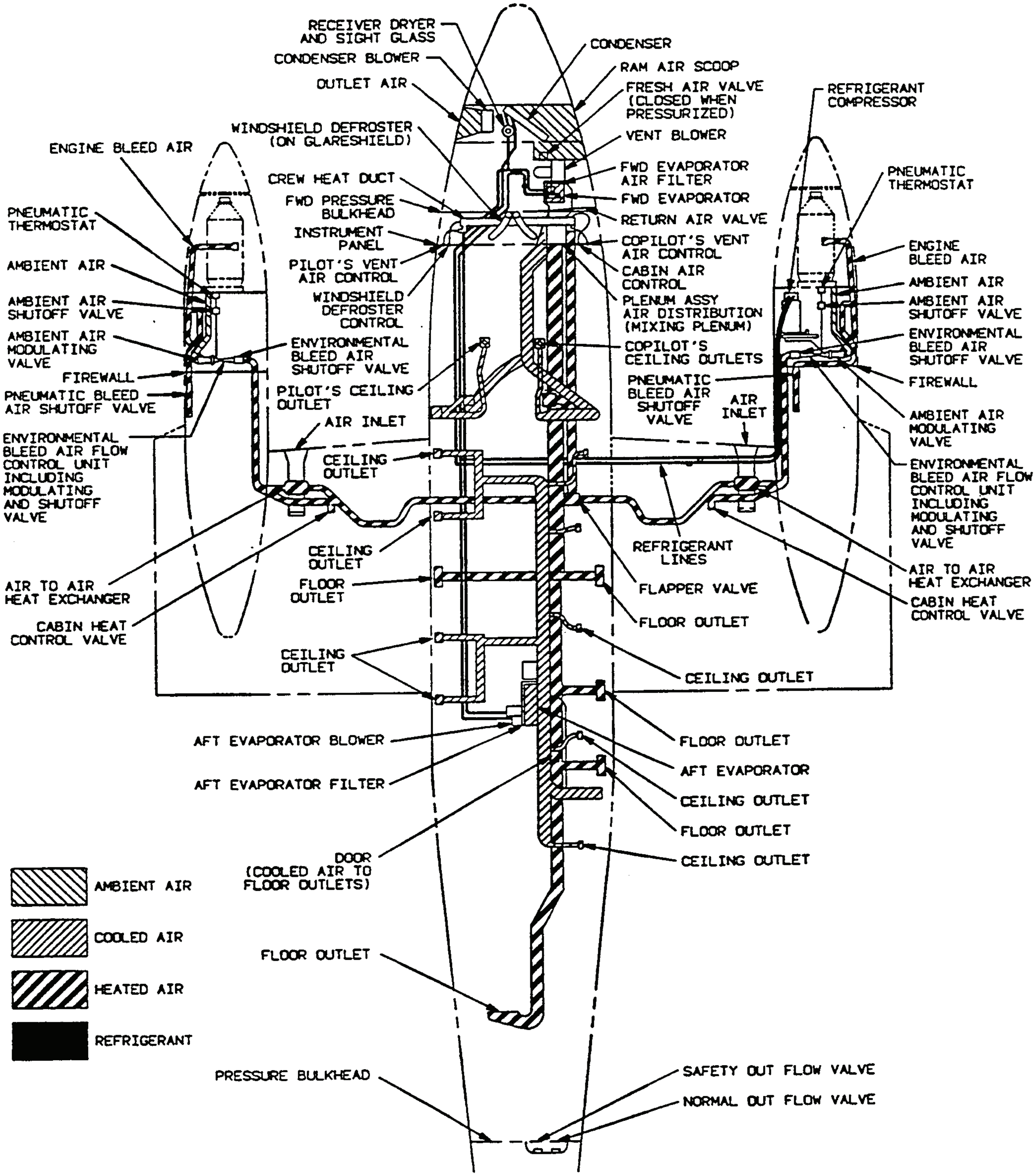


Figure 2-26. Environmental System

c. Bleed Air Valve Switches. The bleed air flow control unit shutoff valve and pneumatic bleed air shutoff valves are controlled by two switches, placarded **LEFT** and **RIGHT BLEED AIR VALVES OPEN** / **ENVIR OFF** / **INSTR & ENVIR OFF**, located on the copilot's subpanel. When set to the **OPEN** position, both the environmental flow control unit shutoff valve and the pneumatic shutoff valve are open. When set to the **ENVIR OFF** position, the environmental flow control unit shutoff valve is closed, and the pneumatic bleed air valve is open. In the **INSTR & ENVIR OFF** position, both are closed. For maximum cooling on the ground, place the bleed air valve switches in the **ENVIR OFF** position.

d. Cabin Temperature Mode Selector Switch. A switch on the copilot's subpanel, placarded **CABIN TEMP MODE OFF** / **AUTO** / **MAN COOL / MAN HEAT**, controls cockpit and cabin heating and air conditioning. When the cabin temperature mode-selector switch is set to the **AUTO** position, the heating and air conditioning systems are automatically controlled. Control signals from the temperature control box are transmitted to the bleed air heat exchanger bypass valves. Here, the bypass valves controlling the amount of air bypassing the heat exchangers regulate the temperature of the air flowing to the cabin. When the temperature of the cabin air has reached the temperature setting of the cabin temperature control rheostat, the automatic temperature control allows hot air to bypass the air-to-air exchangers, admitting hot air into the cabin. When the bypass valves are in the fully closed position, allowing no air to bypass the heat exchangers, the air conditioner begins to operate, providing additional cooling.

e. Cabin Temperature Control Rheostat. A control knob on the copilot's subpanel, placarded **CABIN TEMP INCR**, provides regulation of cabin temperature when the cabin temperature mode-selector switch is set to the **AUTO** position. A temperature sensing unit in the cabin, in conjunction with the setting of the cabin temperature control rheostat, initiates a heat or cool command to the temperature controller for the desired cockpit or cabin compartment environment.

f. Manual Temperature Control Switch. A switch on the copilot's subpanel, placarded **MANUAL TEMP INCR / DECR**, controls cockpit and cabin compartment temperature with the cabin temperature mode selector switch set to the **MAN HEAT** or **MAN HEAT** or **MAN COOL** position. The manual temperature control switch controls the cockpit and cabin temperature by providing a means of manually changing the amount that the bleed air bypass valves are opened. To increase cabin temperature, the switch is held to the **INCR** position. To decrease cabin temperature, the switch is held to the **DECR** position. Approximately 30 seconds per valve is required to drive the bypass valves to the fully open or fully closed position. Only one valve moves at a time.

g. Forward Vent Blower Switch. The forward vent blower is controlled by a switch placarded **VENT BLOWER HIGH / LO / AUTO**, located on the copilot's subpanel. In the **AUTO** position, the fan will run at low speed. The forward vent blower will not operate when the **CABIN TEMP MODE** selector switch is set to the **OFF** position.

h. Aft Vent Blower Switch. The aft vent blower is controlled by the switch placarded **AFT BLOWER ON** / **OFF**, located on the copilot's subpanel. The blower operates continuously when the switch is placed in the **ON** position with the air conditioner compressor operating.

(1) Automatic Heating Mode.

1. **BLEED AIR VALVES** Switches – **OPEN, LEFT** and **RIGHT**.
2. **CABIN TEMP MODE** Switch – **AUTO.**
3. **CABIN TEMP** Rheostat – As required.
4. **CABIN, PILOT, COPILOT**, and **DEFROST AIR** Knobs – As required.

(2) Manual Heating Mode.

1. **BLEED AIR VALVES** Switches – **OPEN**, **LEFT**, and **RIGHT**.
2. **CABIN TEMP MODE** Switch – **MAN HEAT**.
3. **VENT BLOWER** Switches – As required.
4. **MANUAL TEMP** Switch – As required.
5. **CABIN**, **PILOT**, **COPILOT**, and **DEFROST AIR** Knobs – As required.

2-67. AIR CONDITIONING SYSTEM.

a. Description. Cabin air conditioning is provided by a refrigerant-gas, vapor-cycle refrigeration system, Figure 2-26. The system consists of a belt-driven engine-mounted compressor, installed on the #2 engine accessory section, refrigerant plumbing, N_1 speed switch, high and low pressure protection switches, condenser coil, condenser under-pressure switch, condenser blower, forward and aft evaporators, receiver-dryer, expansion valve, and a bypass valve. The plumbing from the compressor is routed through the right inboard wing leading edge to the fuselage and then forward to the condenser coil, receiver-dryer, expansion valve, bypass valve, and forward evaporator, which are located in the nose of the aircraft.

(1) Forward Evaporator. The forward evaporator and blower supplies airflow for the cockpit, forward ceiling outlets, and forward floor outlets. The forward evaporator blower is controlled by a switch placarded **VENT BLOWER HIGH / LO / AUTO**, located on the copilot's subpanel.

(2) Aft Evaporator. The aft evaporator and blower are located in the fuselage center aisle equipment bay, aft of the rear spar. Environmental air is circulated through the evaporator in either manual or automatic control modes. The rear evaporator supplies airflow for the aft ceiling outlets, rear floor outlets, and toilet compartment.

(3) High and Low Pressure Limit Switches. High and low pressure limit switches are provided to prevent compressor operation beyond operational limits. When the low or high-pressure switches are activated, compressor operation will be terminated. When compressor operation has been terminated by limit switch activation, the system should be thoroughly checked before returning it to service.

(4) Thermal Sense Switch. A thermal sense switch is installed on the forward evaporator. This sense switch actuates a hot gas bypass valve that bypasses a portion of the refrigerant from the forward evaporator, thereby preventing icing of the evaporator.

(5) Condenser Blower. A vane-axial blower draws air through the condenser when the aircraft is on the ground.

b. Normal Operation.

(1) Automatic Coding Mode.

1. **BLEED AIR VALVES** Switches – **OPEN, LEFT** and **RIGHT**.
2. **CABIN TEMP MODE** Switch – **AUTO**.
3. **CABIN TEMP** Rheostat – As required.
4. **CABIN, PILOT, COPILOT**, and **DEFROST AIR** Knobs – As required.

(2) Manual Cooling Mode.

1. **BLEED AIR VALVES** Switches – **OPEN, LEFT** and **RIGHT**.

NOTE

For maximum cooling on the ground, set the BLEED AIR VALVES switches to the ENVIR OFF position.

2. **CABIN TEMP MODE** Switch – **MAN COOL**.

2-68. UNPRESSURIZED VENTILATION.

Ventilation is provided by two sources. One source is through the bleed air heating system in both the pressurized and unpressurized mode. The second source of ventilation is obtained from ram air that enters the condenser section in the nose and passes through a check valve in the vent blower plenum. The check valve closes during pressurized operation. Ventilation from this source is in the unpressurized mode only, with the **CABIN PRESS** switch in the **DUMP** position. The check valve closes during pressurized operation. Ram air ventilation is distributed through the main ducting system to all outlets. Moving the ball in the socket can directionally control ventilation air ducted to each individual eyeball cold air outlet. Regulate the volume by twisting the outlet to open or close the valve.

2-69. ENVIRONMENTAL CONTROLS.

An environmental control section on the copilot's subpanel provides for automatic or manual control of the system. This section contains all the major controls of the environmental system: bleed air valve switches, forward and aft vent blower switches, manual temperature switch for control of the heat exchanger valves, cabin temperature level control, and the cabin temperature mode selector switch.

a. Heating Mode.

(1) If the cockpit is too cold:

1. **PILOT** and **COPILOT AIR** Knobs – As required.
2. **DEFROST AIR** Knob – As required.
3. **CABIN AIR** Knob – Pull out in small increments. Allow 3 to 5 minutes after each adjustment for system to stabilize.

(2) If the cockpit is too hot:

1. **CABIN AIR** Knob – As required.

2. **PILOT** and **COPILOT AIR** Knobs – In as required.

3. **DEFROST AIR** Knob – In as required.

b. Cooling Mode.

(1) If the cockpit is too cold:

1. **PILOT** and **COPILOT AIR** Knob – In as required.

2. **DEFROST AIR** Knob – In as required.

3. Overhead Cockpit Outlets – As required.

(2) If the cockpit is too hot:

1. **PILOT** and **COPILOT AIR** Knobs – Out as required.

2. **CABIN AIR** Knob – Close in small increments. Allow 3 - 5 minutes after each adjustment for system to stabilize. If **CABIN AIR** knob is completely closed before obtaining satisfactory cockpit comfort, it may be necessary to place the **AFT BLOWER** switch in the **ON** position to activate the aft evaporator and re-circulate cabin air.

c. Automatic Mode Control. When the **AUTO** mode is selected on the **CABIN TEMP MODE** switch, the heating and air conditioning systems are automatically controlled. When the temperature of the cabin has reached the selected setting, the automatic temperature control allows heated air to bypass the air-to-air exchangers in the wing center section. The warm bleed air is mixed with the cooled air. The rear evaporator picks up re-circulated cabin air only.

When the automatic control drives the environmental system from a heat mode to a cooling mode, the bypass valves close. When the left bypass valve reaches a fully closed position, the refrigeration system will begin cooling, provided the right engine N_1 speed is above 65%. When the bypass valve is opened to a position approximately 30° from full open, the refrigeration system will turn off.

The **CABIN TEMP** control rheostat provides regulation of the temperature level in the automatic mode. A temperature-sensing unit in the cabin, in conjunction with the control setting, initiates a heat or cool command to the temperature controller for desired cockpit and cabin environment.

d. Manual Mode Control. With the **CABIN TEMP MODE** switch in the **MAN HEAT** or **MAN COOL** position, regulation of the cabin temperature is accomplished manually with the **MANUAL TEMP** switch.

*(1) **MAN HEAT** Mode*. In the **MAN HEAT** mode, the automatic system is overridden and the opening and closing of the two bleed air bypass valves using the **MANUAL TEMP** switch controls the system. To increase cabin temperature, hold the switch to the **INCR** position; to decrease cabin temperature, hold the switch in the **DECR** position. Allow approximately 30 seconds per valve to drive the bypass valves to the fully open or fully closed position. Only one valve moves at a time.

*(2) **CABIN TEMP** Mode*. With the **CABIN TEMP MODE** switch in the **MAN COOL** position, the automatic temperature control system is bypassed. When the left bypass valve reaches a fully closed position, the refrigeration system will begin cooling, provided the right engine N_1 speed is above 65%. When the bypass valve is opened to a position approximately 30° from full open, the refrigeration system will turn off. Hold the **MANUAL TEMP** switch to **DECR** position for approximately one minute to fully close air-to-air heat exchanger bypass valves.

(3) Two switches, placarded **LEFT** and **RIGHT BLEED AIR VALVES OPEN / ENVIR OFF / INSTR & ENVIR OFF,** control the bleed air entering the cabin. When a switch is in the **OPEN** position, the environmental flow control unit shutoff valve and the pneumatic shutoff valve are open. When the switch is in the **ENVIR OFF** position, the environmental flow control unit shutoff valve is closed and the pneumatic bleed air valve is open. In the **INSTR & ENVIR OFF** position, both are closed. For maximum cooling on the ground, place the bleed air valve switches in the **ENVIR OFF** position.

(4) Forward Vent Blower. The forward vent blower is controlled by a switch placarded **VENT BLOWER HIGH / LO / AUTO**. The **HIGH** and **LO** positions regulate the blower in two speeds of operation. In the **AUTO** position, the fan will run at low speed except when the **CABIN TEMP MODE** switch is placed in the **OFF** position. In the **OFF** position, the blower will not operate.

(5) Aft Vent Blower. The aft vent blower is controlled by the switch placarded **AFT VENT BLOWER ON / OFF**. The blower operates continuously when the switch is placed in the **ON** position with the air conditioner compressor running.

Section IX. ELECTRICAL POWER SUPPLY AND DISTRIBUTION SYSTEM

2-70. DESCRIPTION.

The aircraft employs both direct current (dc) and alternating current (ac) electrical power. The dc electrical power supply is the basic power system energizing most aircraft circuits. Refer to Figure 2-27 and Table 2-7 R ; Figure 2-28 and Table 2-8 T3; and Figure 2-29 and Table 2-9 F3 . Electrical power is used to start the engines, power the landing gear and flap motors, operate the standby fuel pumps, ventilation blower, lights, and electronic equipment. AC power is obtained from the dc power system through inverters. The single phase ac power system is shown in Figure 2-30, Sheets 1 through 3. The three sources of dc power consist of one 20 cell 34-ampere/hour battery and two 250-ampere starter-generators. DC power may be applied to the aircraft through an external power receptacle on the underside of the right wing, just outboard of the nacelle. Generator control units control the starter generators. The output of each generator passes through a cable to the respective generator bus. Other buses distribute power to aircraft dc loads, deriving power from the generator buses. The generators are paralleled to balance the dc loads between the two units. When one of the generating systems is not on line, and no fault exists, all aircraft dc requirements may be supplied by either the other on-line generating system or by an external power source. The generator system is designed to allow cross starting of the other engine. When one generator is on line, all current limiters are bypassed while starting the other engine. Most dc distribution buses are connected to both generator buses but have isolation diodes to prevent power crossfeed between the generating systems, when connection between the generator buses is lost. Thus, when either generator is lost because of a ground fault, the operating generator will supply power for all aircraft dc loads except those receiving power from the inoperative generator's bus, which cannot be crossfed. When a generator is not operating, reverse current and over-voltage protection is automatically provided. Two inverters operating from dc power produce the required single-phase ac power.

2-71. DC POWER SUPPLY.

One nickel-cadmium battery furnishes dc power when the engines are not operating. This 24-volt 34-ampere/hour battery, located in the right wing center section, is accessible through a panel on the top of the wing. DC power is produced by two engine-driven 28 volt, 250-ampere starter-generators. Controls and indicators associated with the dc supply system are a battery switch, two generator switches, and two dc volt-loadmeters.

a. Battery Switch. A switch, placarded **BATT**, **OFF / ON**, is located on the pilot's subpanel under the **MASTER SWITCH** (gang bar). The **BATT** switch controls dc power to the aircraft bus system through the battery relay, and must be set to **ON** to allow external power to enter aircraft circuits. When the **MASTER SWITCH** (gang bar) is placed down, the **BATT** switch is forced **OFF**.

NOTE

With battery or external power removed from the aircraft electrical system due to fault, power cannot be restored to the system until the BATT switch is moved to OFF, then ON.

b. Generator Switches. Two switches, placarded **GEN 1** and **GEN 2 OFF / ON / GEN RESET**, are located on the pilot's subpanel. These switches control electrical power from the designated generator to paralleling circuits and the bus distribution system. When a generator is removed from the aircraft electrical system, due either to fault or from placing the **GEN** switch in the **OFF** position, the affected unit cannot have its output restored to aircraft use until the **GEN** switch is moved to **RESET**, then **ON**.

c. Master Switch. All electrical current may be shut off using the **MASTER SWITCH** gang bar that extends above the battery and generator switches. When moved downward, the bar positions the switches to the **OFF** position.

d. DC Volt-Loadmeters. Two-volt loadmeters, located on the overhead control panel, Figure 2-31, display bus voltage and current load as a percentage of maximum from the left and right generating systems. The volt-loadmeters normally display load. Voltage may be read by pressing a push-button switch on the respective volt-loadmeter.

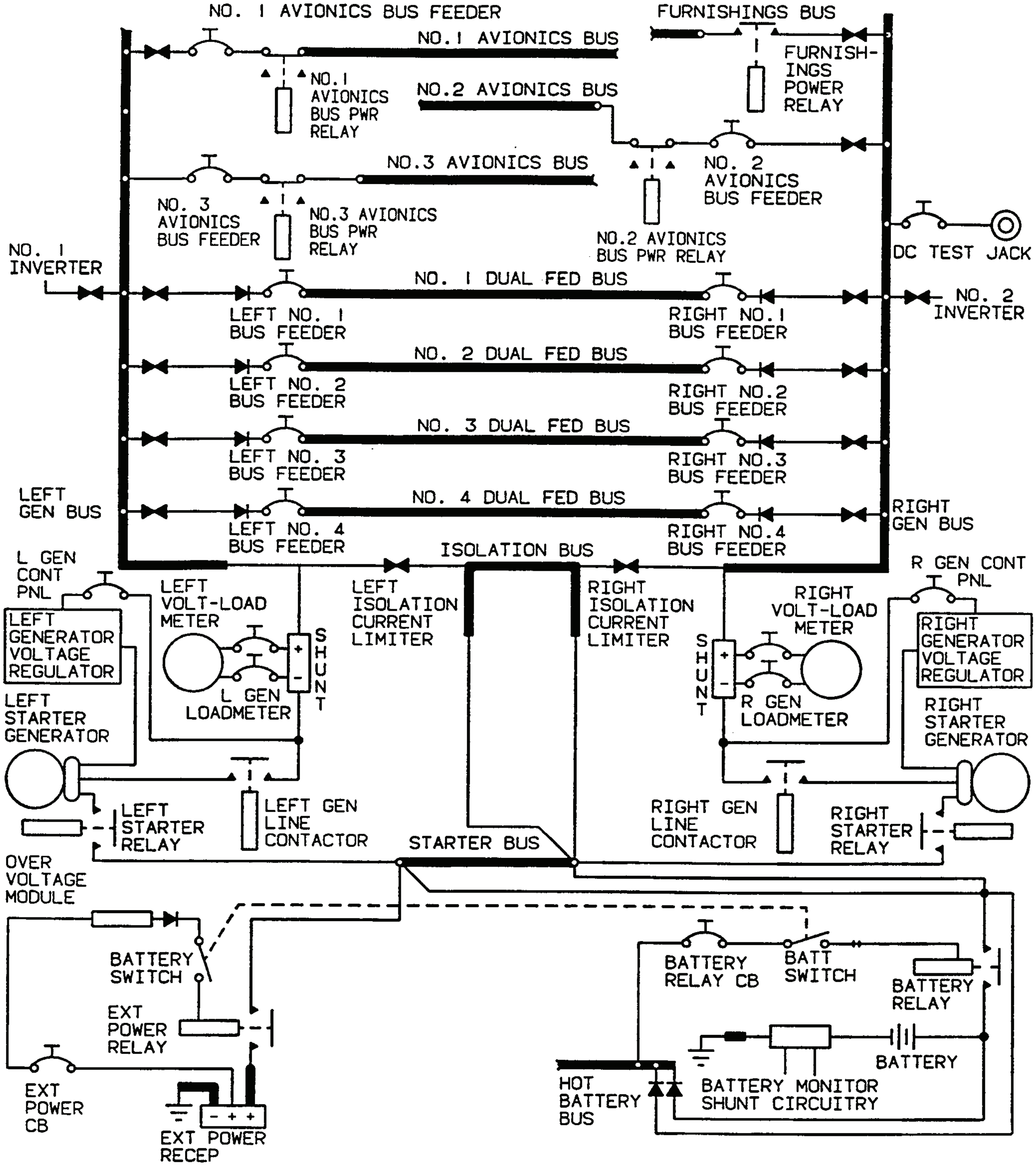


Figure 2-27. DC Electrical System Schematic **R**

Table 2-7. DC Electrical System **R**

FURNISHINGS BUS		
REFRESHMENT BAR	VANITY HEAT AND TOILET	
NO. 1 AVIONICS BUS		
NO. 1 COMM RECEIVER	NO. 1 DME (NAV / TACAN)	NO. I FLIGHT DIRECTOR
NO. 1 NAV RECEIVER	NO. 1 AUTOPILOT	NO. I TRANSPONDER (MODE S)
ADF	NO. 2 RMI	UHF COMM
GPAAS		WEATHER MAPPING SYSTEM
NO. 2 AVIONICS BUS		
NO. 2 COMM TRANSCEIVER	NO. 2 AUTOPILOT	STANDBY ALTIMETER
NO. 2 NAV RECEIVER	NO. 2 TRANSPONDER (IFF)	HF RECEIVE
NO. 2 DME	TRANSPONDER EMERGENCY MODE	NO. 1 RMI
NO. 2 FLIGHT DIRECTOR		
NO. 3 AVIONICS BUS		
RADAR	FLIGHT MANAGEMENT SYSTEM	STANDBY GYRO HORIZON
HF TRANSMIT	GLOBAL POSITIONING SYSTEM	STANDBY GYRO HORIZON BATTERY
RADIO ALTIMETER		AIRBORNE TELEPHONE
LEFT GENERATOR BUS		
PILOT WINDSHIELD ANTI-ICE		
RIGHT GENERATOR BUS		
COPILOT WINDSHIELD ANTI-ICE	AFT EVAPORATOR SLOWER VENT BLOWER	AIR CONDITIONER CLUTCH
NO. 1 DUAL FED BUS		
AVIONICS MASTER CONTROL	LEFT PITOT HEAT	PROP AUTO HEAT
TAIL FLOOD LIGHTS	BEACON LIGHTS	STROBE LIGHTS
LEFT LANDING LIGHT	LEFT GENERATOR CONTROL	LEFT ENGINE INSTRUMENTS
LEFT MAIN ENGINE ANTI-ICE	LEFT ENGINE FUEL CONTROL HEAT	LEFT BLEED AIR CONTROL
LEFT STANDBY ENGINE ANTI-ICE	FIRE DETECTOR	LEFT CHIP DETECTOR
PROP SYNC	BRAKE DEICE	PNEUMATIC SURFACE DEICE
LEFT FUEL VENT HEAT	ANNUNCIATOR POWER	LANDING GEAR WARNING HORN
LEFT BLEED AIR WARNING	STALL WARN	AUTOPILOT TRANSFER
PILOT VS / ALTIMETER	PILOT EADI	PILOT AUDIO
PILOT TURN AND SLIP INDICATOR	OUTSIDE AIR TEMPERATURE	CABIN LIGHTS
PILOT AIR DATA	AUTO OXYGEN CONTROL	AVIONICS AND ENGINE AUTO INSTRUMENT LIGHTS
PILOT EHSI	AURAL WARNING	CABIN PRESSURE CONTROL
EFIS AUXILIARY BATTERY	COCKPIT VOICE RECORDER	SIDE PANEL / OVERHEAD FLOOD LIGHTS
PILOT FLIGHT INSTRUMENT LIGHTS		

Table 2-7. DC Electrical System **R** *(Continued)*

NO. 2 DUAL FED BUS		
STALL WARNING HEAT	RIGHT PITOT HEAT	LANDING GEAR CONTROL
TAXI LIGHT	NAV LIGHTS	ICE LIGHTS
RIGHT ENGINE INSTRUMENTS	RIGHT LANDING LIGHT	RIGHT ENGINE FUEL CONTROL HEAT
RIGHT MAIN ENGINE ANTI-ICE	RIGHT STANDBY ENGINE ANTI-ICE	RIGHT CHIP DETECTOR
AUTOFEATHER	WINDSHIELD WIPER	RIGHT FUEL VENT HEAT
ANNUNCIATOR INDICATOR	INSTRUMENT INDIRECT LIGHTS	RIGHT BLEED AIR WARNING
COPILOT FLIGHT INSTRUMENT LIGHTS	OVERHEAD, SUBPANEL, AND CONSOLE LIGHTS	LANDING GEAR POSITION INDICATOR
CABIN READING LIGHTS	RIGHT GENERATOR CONTROL	RUDDER BOOST CONTROL
CABIN AUDIO	RIGHT BLEED AIR CONTROL	CABIN TEMP CONTROL
COPILOT VS / ALT	COPILOT EADI	MULTIFUNCTION DISPLAY
COPILOT AUDIO	COPILOT TURN AND SLIP INDICATOR	COPILOT EHSI
STANDBY EFIS ADI	COPILOT AIR DATA	CIGARETTE LIGHTER
NO. 3 DUAL FED BUS		
LEFT MANUAL PROP DEICE	FLAP MOTOR	FLAP CONTROL AND INDICATOR
LEFT IGNITOR POWER	LEFT START CONTROL	LEFT FIREWALL VALVE
LEFT STANDBY PUMP	LEFT FUEL PRESSURE WARNING	LEFT FUEL QUANTITY
LEFT AUX FUEL QUANTITY WARNING AND TRANSFER		
NO. 4 DUAL FED BUS		
RIGHT MANUAL PROP DEICE	MANUAL PROP DEICE CONTROL	PROP GOVERNOR
RIGHT IGNITOR POWER	RIGHT START CONTROL	RIGHT FIREWALL VALVE
RIGHT STANDBY PUMP	RIGHT FUEL PRESSURE WARNING	RIGHT FUEL QUANTITY
RIGHT AUX FUEL QUANTITY WARNING AND TRANSFER	FUEL CROSSFEED	
HOT BATTERY BUS		
LEFT FIREWALL FUEL SHUTOFF VALVE	LEFT ENGINE FIRE EXTINGUISHER	NAV MEMORY
RIGHT FIREWALL FUEL SHUTOFF VALVE	RIGHT ENGINE FIRE EXTINGUISHER	ENTRY LIGHTS
BATTERY RELAY		

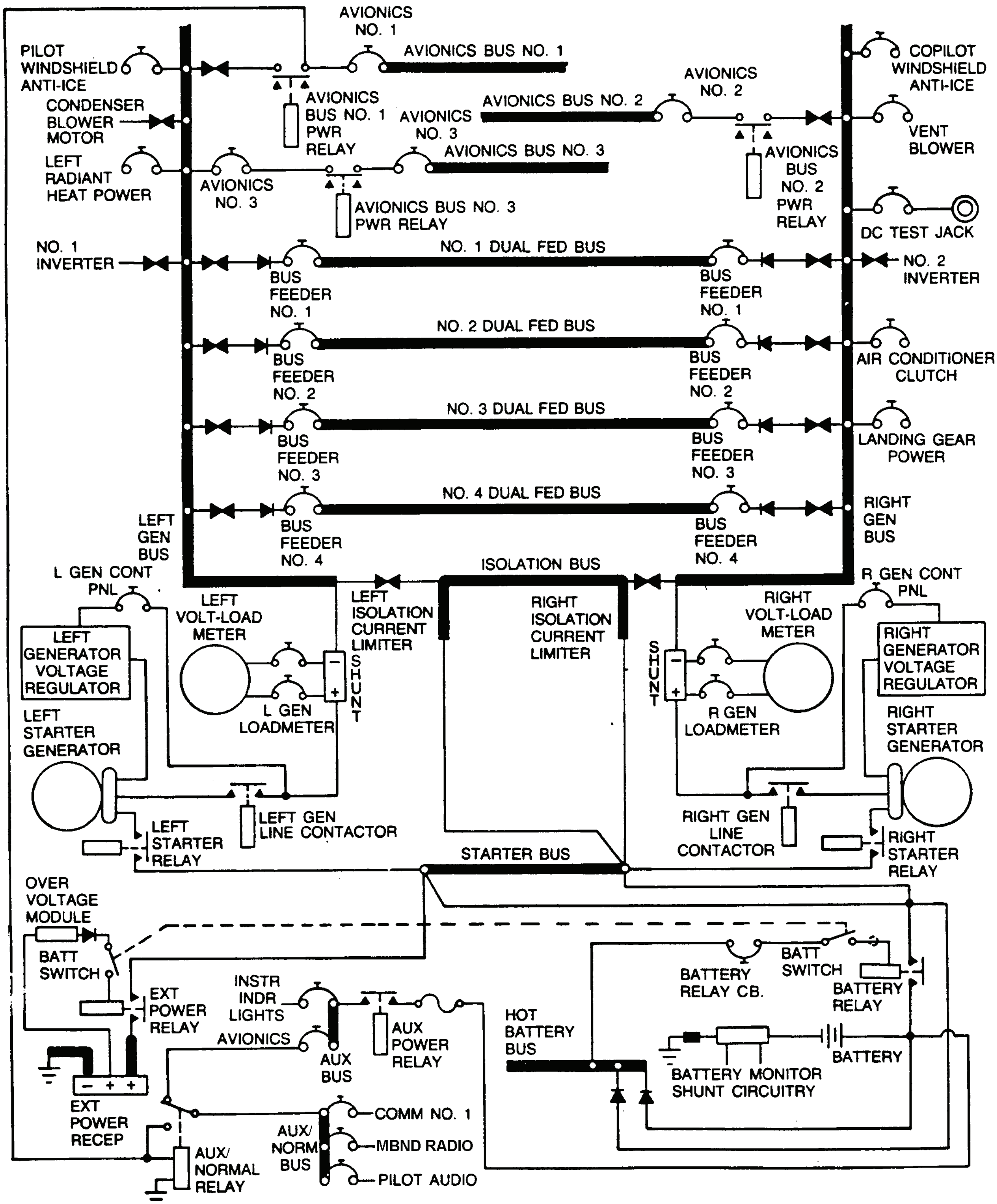


Figure 2-28. DC Electrical System Schematic T3

Table 2-8. DC Electrical System T3

NO. 1 AVIONICS BUS		
NAV NO. 1	STORMSCOPE	AFCS. NO. 1
ADF	RADIO RELAY	TCAS
FMS 1	AP CONTROL	MODE S XPONDER NO. 1
DME	AIR DATA ENCODER	
NO. 2 AVIONICS BUS		
COMM NO. 2	RADAR	RADIO ALTM
NAV NO. 2	TCAS REMOTE ENCODER 2	FMS 2
COPILOT AUDIO	IFF XPNDR NO. 2	GPWS
RADAR DISPLAY	AFCS NO. 2	
NO. 3 AVIONICS BUS		
OAT PROBE HEAT	HF RCV	HF POWER
AUX NORM BUS		
COMM NO. 1	MBND	PILOT AUDIO
AUX BUS		
INSTR INDIRECT LIGHTS		
NO. 1 DUAL FED BUS		
* LEFT LANDING LIGHT	ENG LEFT OIL PRESS	BRAKE DEICE
* RED ANTICOLLISION LIGHT	ENG LEFT FUEL FLOW	SURF DEICE
* WHITE ANTICOLLISION LIGHT	AVIONICS MASTER CONTROL	LEFT FUEL VENT
* LEFT PITOT HEAT	EADI NO. 1	SIDE PANEL LIGHTS
* PROP AUTO HEAT	EHSI NO. 1	FLIGHT INSTR LIGHTS
PROP SYNC	CP NO. 1	AVIONICS ANN
LEFT CHIP DETECTOR	DCU NO. 1	NO. 1 INV CONTROL
LEFT GEN OVERHEAT	ANNUNCIATOR POWER WARNING	LEFT GEN CONTROL
FIRE DETECTOR	LANDING GEAR WARNING	OXYGEN CONTROL
ENG LEFT ICE VANE CONTROL	LEFT BLEED AIR WARNING	PRESS CONTROL
ENG LEFT FUEL CONTROL HEAT	STALL WARN	LEFT BLEED AIR CONTROL
ENG LEFT OIL TEMP	BAT TEMP WARNING	
ENG LEFT PRESS WARN	PILOT TURN AND SLIP INDICATOR, ALT ALERT, STBY HRZN, AUX BAT, PITCH TRIM	
NO. 2 DUAL FED BUS		
* STALL WARNING HEAT	RIGHT OIL TEMP	READING LIGHTS
* RIGHT PITOT HEAT	RIGHT OIL PRESS WARN	NO. 2 INV CONTROL
* NAV	RIGHT OIL PRESS	RIGHT GEN CONTROL
AUTOFEATHER	RIGHT FUEL FLOW	ANN IND WARNING
EADI NO. 2	LANDING GEAR RELAY	LANDING GEAR IND WARNING
EHSI NO. 2	* TAXI	TEMP CONTROL
CP NO. 2	* RIGHT LANDING	RIGHT BLEED AIR CONTROL

* Indicates switch type circuit breakers

Table 2-8. DC Electrical System T3 (Continued)

NO. 2 DUAL FED BUS (Continued)		
DCU NO. 2	WSHLD WIPER	RUDDER BOOST
RIGHT CHIP DETECTOR	RIGHT FUEL VENT	COPILOT ALTIMETER
RIGHT GEN OVERHEAT	NO SMK & CABIN LIGHTS	XPONDER EMER CODE
RIGHT ICE VANE CONTROL	SUBPNL OVHD & CONSOLE LIGHTS	MASTER POWER
RIGHT FUEL CONTROL HEAT	AVIONICS & ENG INSTR LIGHTS	CIGARETTE LIGHTER
NO. 3 DUAL FED BUS		
LEFT MANUAL PROP DEICE	FLAP MOTOR	FLAP CONTROL AND INDICATOR
LEFT IGNITOR POWER	LEFT START CONTROL	LEFT FIREWALL VALVE
LEFT STANDBY PUMP	LEFT FUEL PRESSURE WARNING	LEFT FUEL QUANTITY
LEFT AUX FUEL QUANTITY WARNING AND TRANSFER		
NO. 4 DUAL FED BUS		
RIGHT MANUAL PROP DEICE	MANUAL PROP DEICE CONTROL	PROP GOVERNOR
RIGHT IGNITOR POWER	RIGHT START CONTROL	RIGHT FIREWALL VALVE
RIGHT STANDBY PUMP	RIGHT FUEL PRESSURE WARNING	RIGHT FUEL QUANTITY INDICATOR
RIGHT AUX FUEL QUANTITY WARNING AND TRANSFER	FUEL CROSSFEED	
HOT BATTERY BUS		
LEFT FIREWALL FUEL SHUTOFF VALVE	ENTRY LIGHTS	
RIGHT FIREWALL FUEL SHUTOFF VALVE	NAV MEMORY (Not Used)	
BATTERY RELAY		
* Indicates switch type circuit breakers		

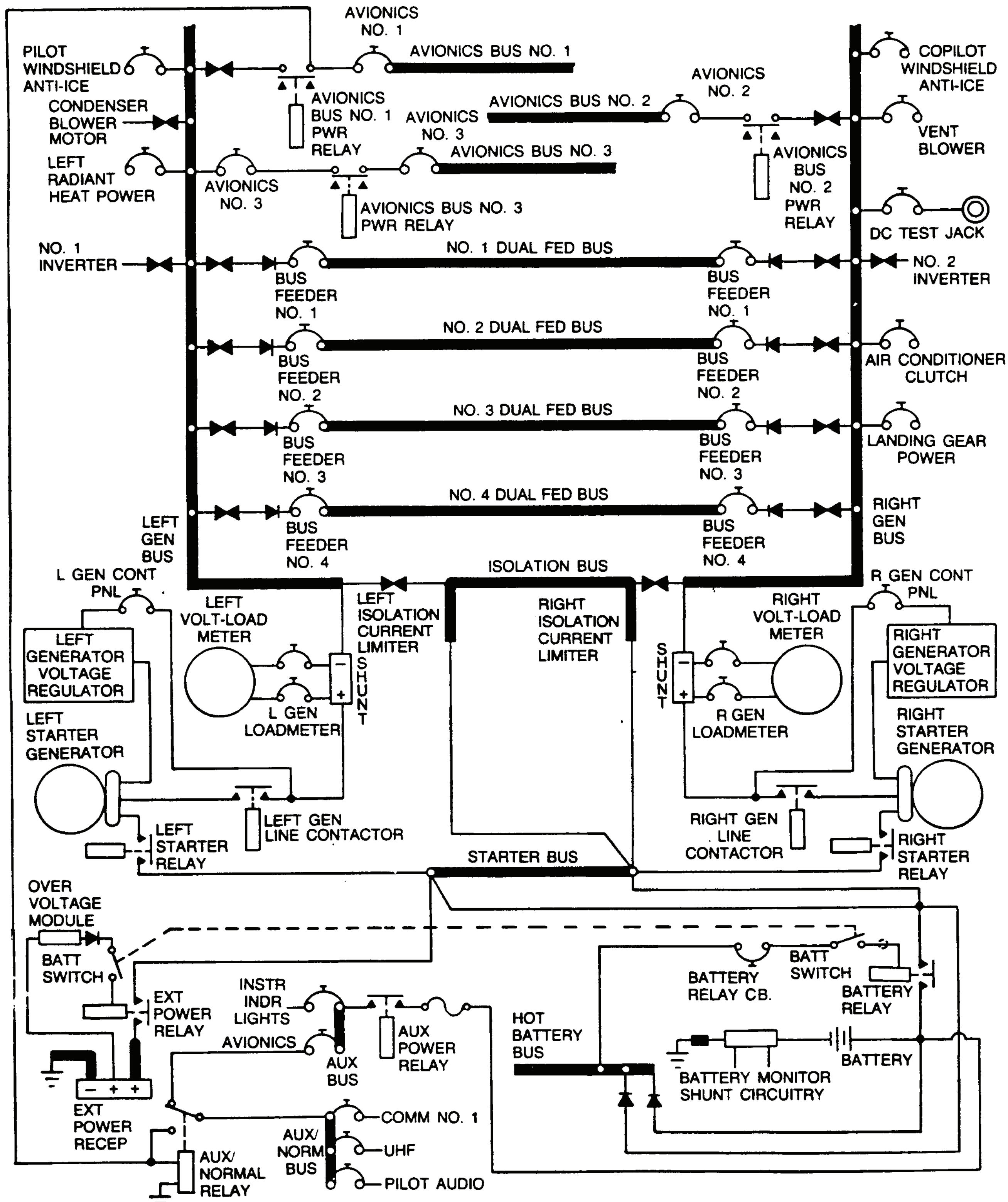


Figure 2-29. DC Electrical System Schematic F3

Table 2-9. DC Electrical System F3

NO. 1 AVIONICS BUS

NAV NO. 1	STORMSCOPE	AIR DATA ENCODER
ADF	RADIO RELAY	AFCS. NO. 1
RMI NO. 2	AP CONTROL	CMPTER MON
DME		

NO. 2 AVIONICS BUS

COMM NO. 2	RADAR	RADIO ALTM
NAV NO. 2	RMI NO. 1	TACAN
COPILOT AUDIO	XPNDR	GPWS
RADAR DISPLAY	AFCS NO. 2	KLN 90B

NO. 3 AVIONICS BUS

TAS / TAT / SAT PROBE	HF RCV	HF POWER

AUX NORM BUS

COMM NO. 1	UHF	PILOT AUDIO

AUX BUS

INSTR INDIRECT LIGHTS		

NO. 1 DUAL FED BUS

* LEFT LANDING LIGHT	ENG LEFT OIL PRESS	BRAKE DEICE
* RED ANTICOLLISION LIGHT	ENG LEFT FUEL FLOW	SURF DEICE
* WHITE ANTICOLLISION LIGHT	AVIONICS MASTER CONTROL	LEFT FUEL VENT
* LEFT PITOT HEAT	EADI NO. 1	SIDE PANEL LIGHTS
* PROP AUTO HEAT	EHSI NO. 1	FLIGHT INSTR LIGHTS
PROP SYNC	CP NO. 1	AVIONICS ANN
LEFT CHIP DETECTOR	DCU NO. 1	NO. 1 INV CONTROL
LEFT GEN OVERHEAT	LANDING GEAR WARNING	LEFT GEN CONTROL
FIRE DETECTOR	LEFT BLEED AIR WARNING	OXYGEN CONTROL
ENG LEFT ICE VANE CONTROL	STALL WARN	PRESS CONTROL
ENG LEFT OIL TEMP	BAT TEMP WARNING	LEFT BLEED AIR CONTROL
ENG LEFT PRESS WARN	ENG LEFT FUEL CONTROL HEAT	ANNUNCIATOR POWER WARNING
PILOT TURN AND SLIP INDICATOR, ALT ALERT, STBY HRZN, AUX BAT, PITCH TRIM		

NO. 2 DUAL FED BUS

* STALL WARNING HEAT	RIGHT OIL TEMP	READING LIGHTS
* RIGHT PITOT HEAT	RIGHT OIL PRESS WARN	NO. 2 INV CONTROL
* NAV	RIGHT OIL PRESS	RIGHT GEN CONTROL
AUTOFEATHER	RIGHT FUEL FLOW	ANN IND WARNING
EADI NO. 2	LANDING GEAR RELAY	LANDING GEAR IND WARNING
EHSI NO. 2	* TAXI	TEMP CONTROL
CP NO. 2	* RIGHT LANDING	RIGHT BLEED AIR CONTROL

* Indicates switch type circuit breakers

Table 2-9. DC Electrical System F3 *(Continued)*

NO. 2 DUAL FED BUS (Continued)		
DCU NO. 2	WSHLD WIPER	RUDDER BOOST
RIGHT CHIP DETECTOR	RIGHT FUEL VENT	COPILOT ALTIMETER
RIGHT GEN OVERHEAT	NO SMK & CABIN LIGHTS	XPONDER EMER CODE
RIGHT ICE VANE CONTROL	SUBPNL OVHD & CONSOLE LIGHTS	MASTER POWER
RIGHT FUEL CONTROL HEAT	AVIONICS & ENG INSTR LIGHTS	CIGARETTE LIGHTER
NO. 3 DUAL FED BUS		
LEFT MANUAL PROP DEICE	FLAP MOTOR	FLAP CONTROL AND INDICATOR
LEFT IGNITOR POWER	LEFT START CONTROL	LEFT FIREWALL VALVE
LEFT STANDBY PUMP	LEFT FUEL PRESSURE WARNING	LEFT FUEL QUANTITY
LEFT AUX TRANSFER		
NO. 4 DUAL FED BUS		
RIGHT MANUAL PROP DEICE	MANUAL PROP DEICE CONTROL	PROP GOVERNOR
RIGHT IGNITOR POWER	RIGHT START CONTROL	RIGHT FIREWALL VALVE
RIGHT STANDBY PUMP	RIGHT FUEL PRESSURE WARNING	RIGHT FUEL QUANTITY INDICATOR
RIGHT AUX FUEL QUANTITY WARNING AND TRANSFER	FUEL CROSSFEED	
HOT BATTERY BUS		
LEFT FIREWALL FUEL SHUTOFF VALVE	ENTRY LIGHTS	
RIGHT FIREWALL FUEL SHUTOFF VALVE	NAV MEMORY (Not Used)	
BATTERY RELAY		
* Indicates switch type circuit breakers		

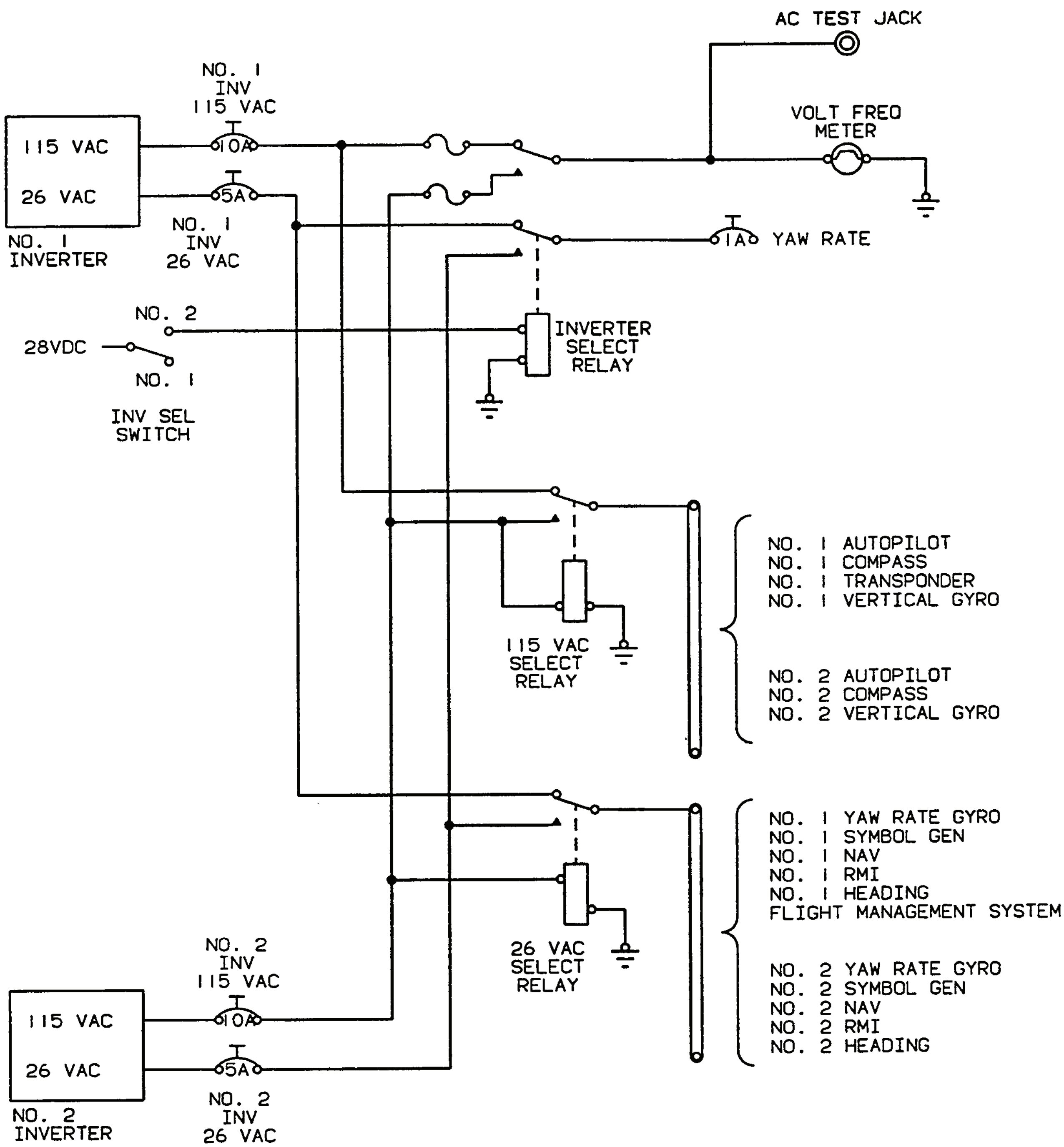


Figure 2-30. Single Phase AC Electrical System **R** *(Sheet 1 of 3)*

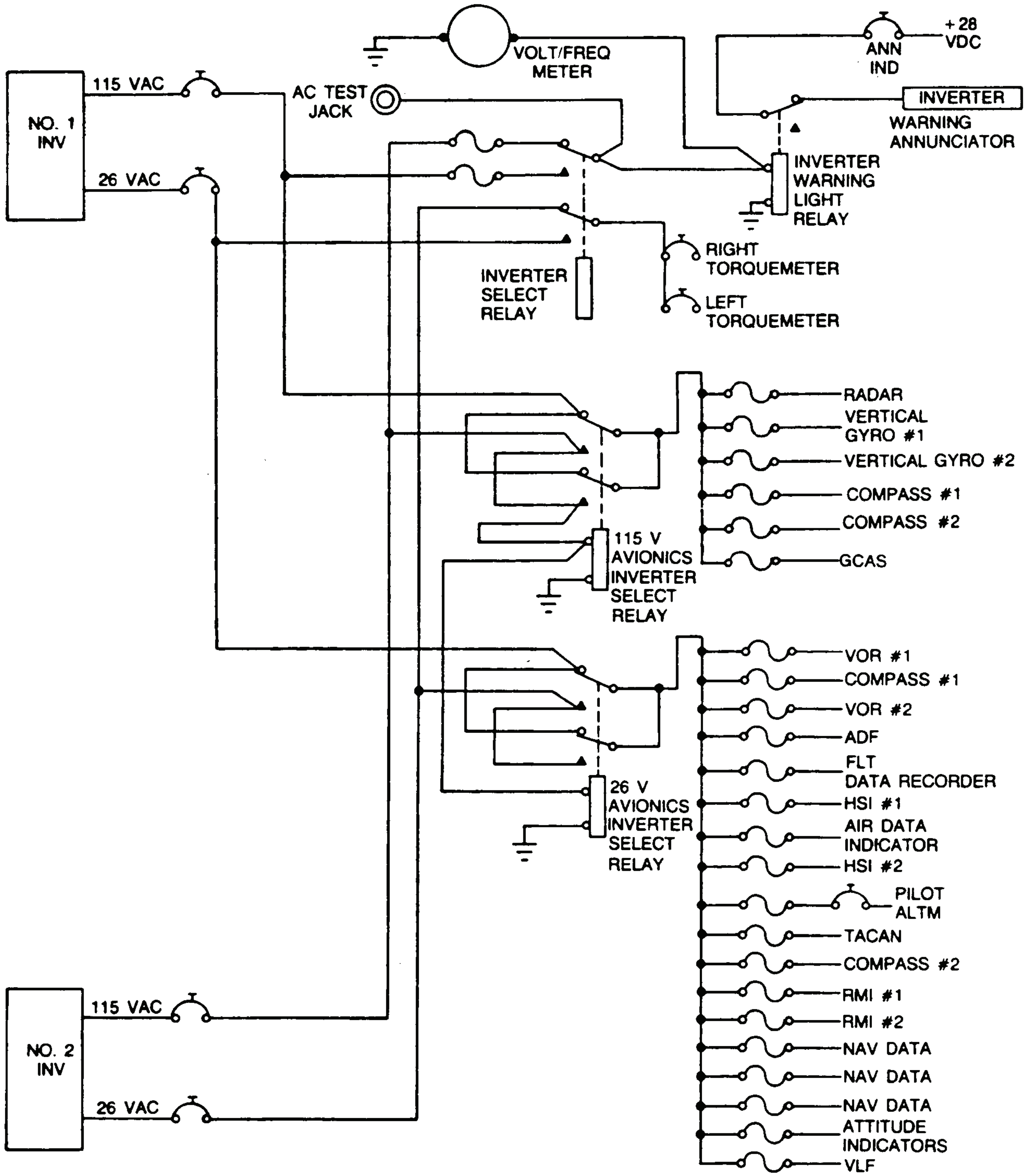


Figure 2-30. Single Phase AC Electrical System T3 F3 ANG (Sheet 2 of 3)

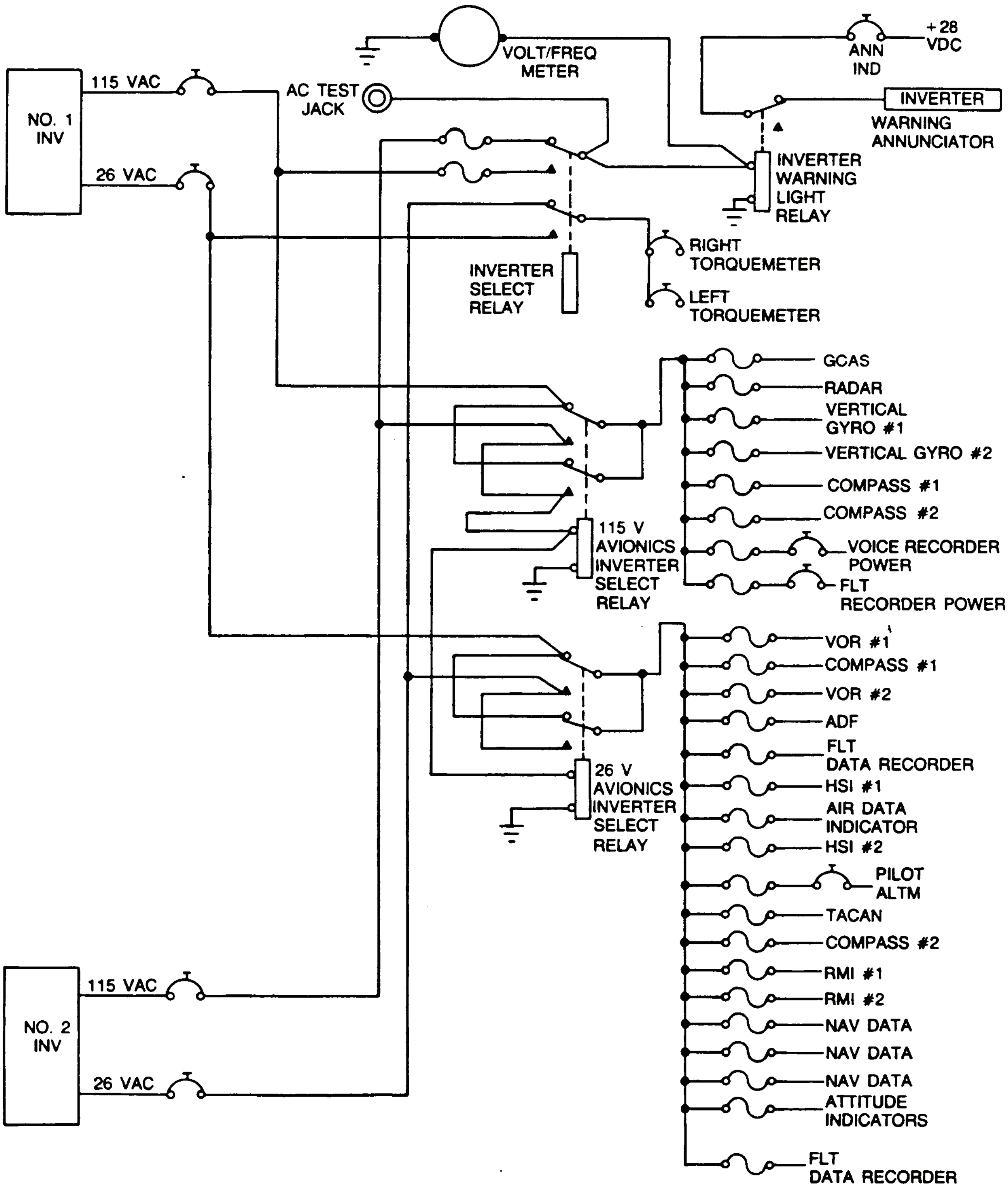


Figure 2-30. Single Phase AC Electrical System **T3** **F3** **OSA** *(Sheet 3 of 3)*

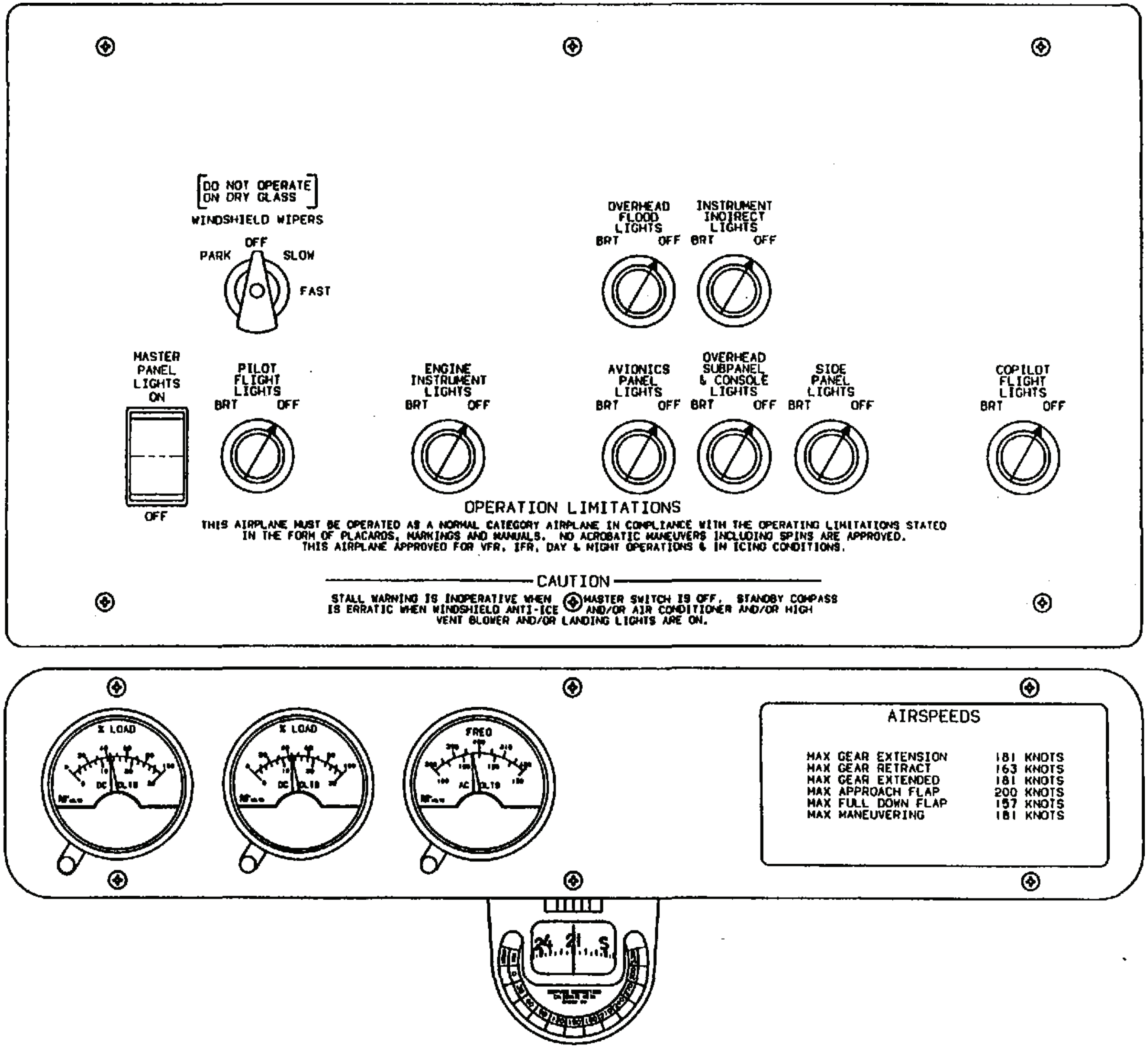


Figure 2-31. Overhead Control Panel R (Sheet 1 of 2)

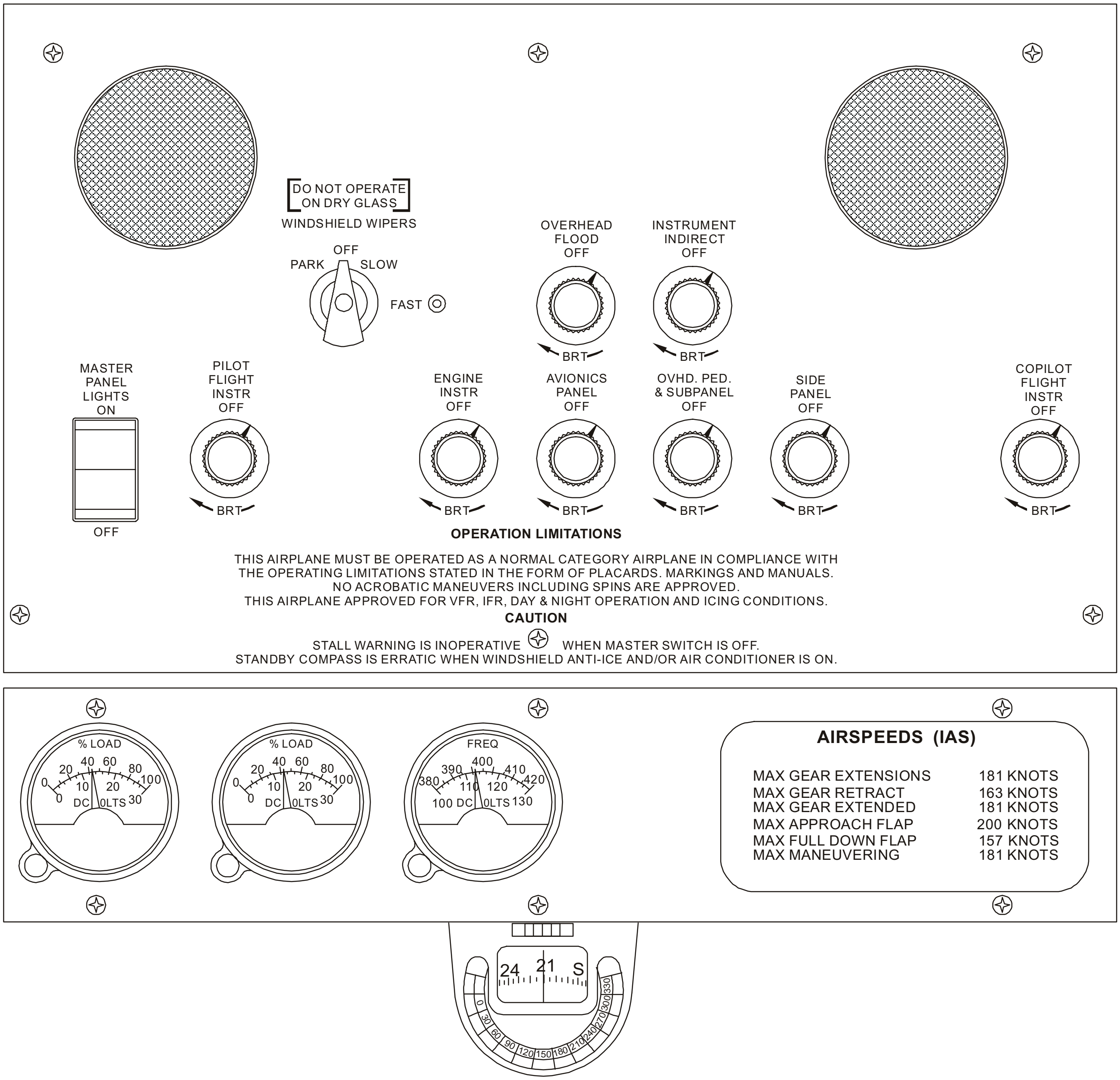


Figure 2-31. Overhead Control Panel T3 F3 (Sheet 2 of 2)

e. Battery Charge Monitor. Nickel-cadmium battery overheating will cause the battery charge current to increase if thermal runaway is imminent. The aircraft has a charge-current sensor that will detect a charge current. The charge current system senses battery current through a shunt in the negative lead of the battery. Any time the battery charging current exceeds approximately 7 amperes for 6 seconds or longer, the yellow **BATTERY CHG** annunciator and the **MASTER CAUTION** annunciator will illuminate. Following a battery engine start, the caution annunciator will illuminate approximately 6-seconds after the generator switch is placed in the **ON** position. The annunciator will normally extinguish within 2 to 5 minutes, indicating that the battery is approaching a full charge. The time interval will increase if the battery has a low state of charge, the battery temperature is very low, or if the battery has previously been discharged at a very low rate (i.e., battery operation of radios or lights for prolonged periods). The caution annunciator may also illuminate for short intervals after landing gear and/or flap operation. If the caution annunciator should illuminate during normal steady-state cruise, this indicates that conditions exist that may cause a battery thermal runaway. If this occurs, the battery current should be monitored using the volt-loadmeters. If battery current continues to increase, the battery is in thermal runaway and should be selected **OFF** and may be turned back **ON** only for gear and flap extension and approach to landing.

f. Generator Out Warning Annunciators. Two caution/advisory annunciator panel fault annunciators inform the pilot when either generator is not delivering current to the aircraft dc bus system. These annunciators are placarded **L DC GEN** and **R DC GEN**. Illumination of the two **MASTER CAUTION** annunciators and either fault annunciator indicates that either the identified generator has failed or voltage is not sufficient to keep it connected to the power distribution system.

CAUTION

The GPU shall be adjusted to regulate at 28.0 to 28.4 volts. The GPU shall be capable of producing 1000 amps capacity, 500 amperes for 2 minutes, and 300 amps maximum continuous.

g. DC External Power Source. External dc power can be applied to the aircraft through an external power receptacle on the underside of the right wing, just outboard of the engine nacelle. The receptacle is installed inside the wing structure and is accessible through a hinged access panel. DC power is supplied through the dc external power plug, through the external power relay, directly to the battery bus. Turn off all external power while connecting the power cable to, or removing it from, the external power supply receptacle. The holding coil circuit of the relay is energized by the external power source when the battery switch is in the **ON** position. The GPU shall be adjusted to regulate at 28.2 volts maximum to prevent damage to the aircraft battery. The **EXT PWR** annunciator indicates that the dc external power plug is connected.

h. Circuit Breakers. The right and left sidewall circuit breaker panels contain the circuit breakers for most aircraft systems. The circuit breakers on the panels are grouped into areas that are placarded as to their general function. A DC power distribution panel is mounted beneath the aisle, forward of the main spar. This panel contains higher current rated circuit breakers and is not accessible to the flight crew under normal conditions.

2-72. AC POWER SUPPLY.

a. AC Power. AC power for the aircraft is supplied by two single-phase inverters, which obtain operational current from the dc power system. Each inverter provides 115 and 26 volts, 400 Hz ac output. The inverters are protected by circuit breakers mounted on the dc power distribution panel mounted beneath the floor.

(1) AC Power Annunciators. Illumination of the two **MASTER WARNING** annunciators, and the illumination of the **INVERTER** warning annunciator indicates inverter failure.

(2) Inverter Control Switches. The inverters are controlled by a switch placarded **INVERTER NO. 1 / OFF / NO. 2**, located on the pilot's subpanel.

b. Volt-Frequency Meter. A volt-frequency meter is located on the overhead control panel. A reading of 115 Vac and 400 hertz will indicate normal bus conditions. The volt-frequency meter normally displays frequency. Voltage may be read by pressing a push-button switch on the meter.

Section X. LIGHTING

2-73. EXTERIOR LIGHTING.

Exterior lighting consists of navigation lights, two strobe beacons/anticollision lights, three white strobe lights, two recognition lights, two ice lights, two tail floodlights (R), and an entry light. Refer to Figure 2-32 for details and locations.

a. Navigation Lights. One navigation light is located on the aft end of the aft portion of the vertical stabilizer and one standard navigation light on the outside of each wing tip. The navigation lights are controlled by, and the circuit is protected by, a 5-ampere circuit breaker switch, placarded **NAV**, located on the pilot's subpanel.

b. Beacon/Anti-collision. One beacon/anticollision light is installed on the underside of the fuselage, and another is installed on top of the horizontal stabilizer. These lights are controlled by, and a 10-ampere circuit-breaker switch, placarded **BEACON** (R**)** or **RED ANTI-COLLISION** (F3/T3), located on the pilot's subpanel protects their circuits.

c. Strobe Lights. One white strobe light is installed on each wing tip and one is installed on the tail. A 5-ampere circuit-breaker switch, placarded **STROBE** (R) or **WHITE ANTI-COLLISION** (F3/T3), located on the pilot's subpanel controls these lights.

NOTE

Landing lights are not automatically turned off when the landing gear is retracted.

d. Landing Lights. Dual landing lights are mounted on the nose gear assembly. The lights are controlled by two 10-ampere circuit-breaker switches placarded **LANDING LEFT** and **LANDING RIGHT**, located on the pilot's subpanel. A green advisory light, placarded **LDG / TAXI LIGHT**, located on the aircraft annunciator panel, indicates the landing lights are selected **ON** with the landing gear retracted.

NOTE

The taxi light is not automatically turned off when the landing gear is retracted.

e. Taxi Light. A single taxi light is mounted on the nose gear assembly. The taxi light is controlled by a 15-ampere circuit-breaker switch placarded **TAXI**, located on the pilot's subpanel. A green advisory light, placarded **LDG / TAXI LIGHT**, located on the aircraft annunciator panel indicates the taxi light is selected **ON** with the landing gear retracted.

f. Ice Lights. The ice lights are controlled by, and the circuit is protected by, a 5-ampere circuit-breaker switch, placarded **ICE**, on the pilot's subpanel.

g. Recognition Lights. A white recognition light is mounted in the leading edge of each wing tip. The recognition lights are controlled by, and the circuit is protected by, a 7-1/2-ampere circuit-breaker switch, placarded **RECOG**, located on the pilot's subpanel.

h. Tail Floodlights R . A white tail floodlight is mounted on the outboard underside of each horizontal stabilizer to illuminate each side of the vertical stabilizer. The tail floodlights are controlled by, and the circuit is protected by, a 7-1/2-ampere circuit-breaker switch placarded **TAIL FLOOD**, located on the pilot's subpanel.

i. Entry Light. A flush-mounted floodlight, located forward of the flap on the bottom surface of the left wing, provides illumination of the ramp area around the airstair door. The threshold light switch that is located just inside the cabin door on the forward doorframe controls the entry light. The entry light will extinguish automatically when the cabin door is closed.

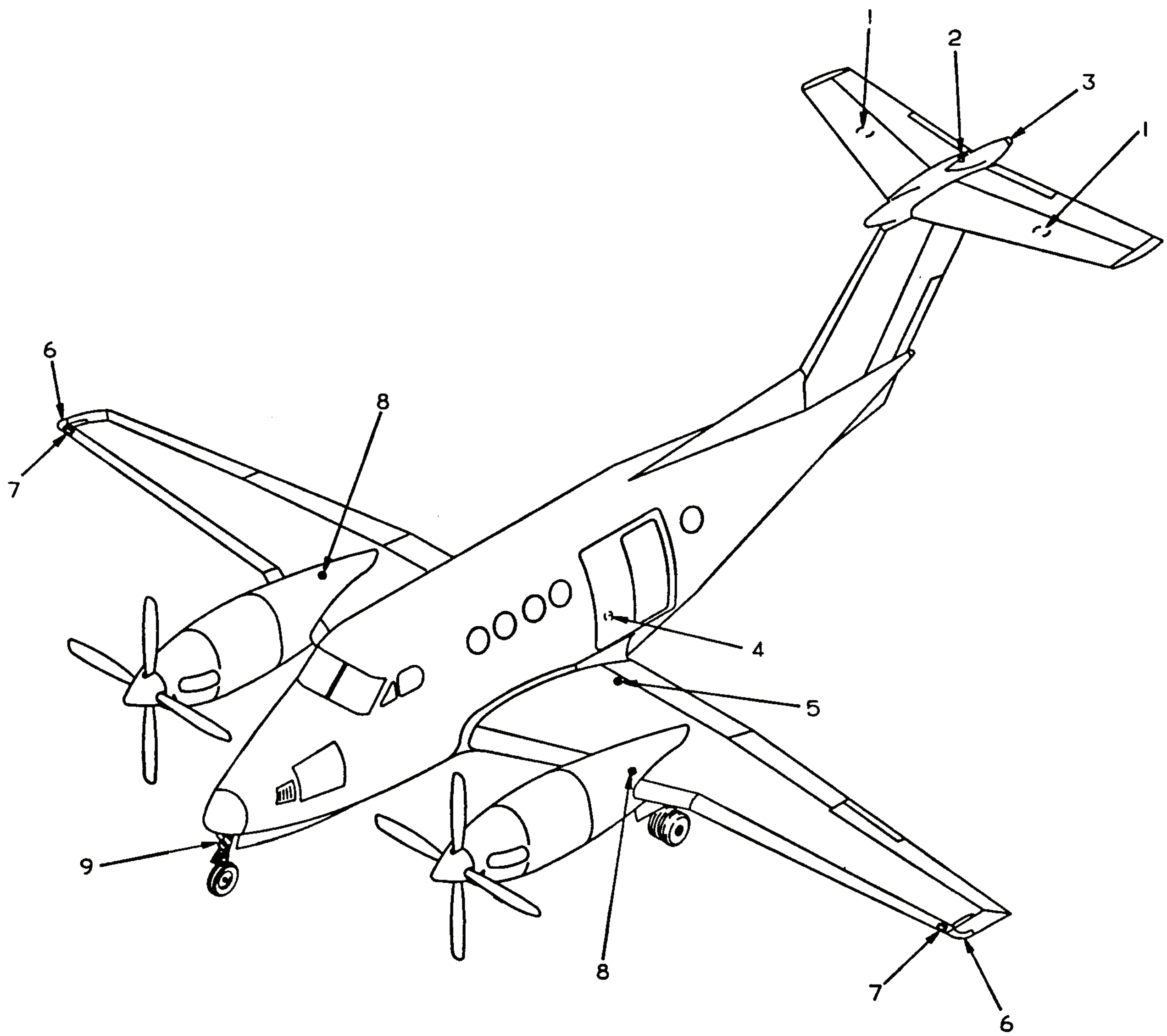
2-74. INTERIOR LIGHTING.

a. Cockpit Lighting.

(1) Master Panel Lights Switch. A switch placarded **MASTER PANEL LIGHTS ON** / **OFF**, located on the overhead control panel controls cockpit lighting. Refer to Figure 2-31 for interior lighting switches and locations.

(2) Overhead Flood Lights. Overhead floodlight(s), one (F3/T3) or two (R), are installed in the cockpit to provide overall illumination. The light(s) are controlled by a rheostat switch placarded **OVERHEAD FLOODLIGHTS BRT / OFF**, located on the overhead control panel. The overhead floodlight(s) circuit is protected by a 7-1/2-ampere circuit breaker placarded **SUB PNL, OVHD & CONSOLE** located on the right sidewall circuit breaker panel.

(3) Instrument Indirect Lights. Lights in the glareshield provide indirect lighting to the instrument panel. The instrument indirect lights are controlled by a rheostat switch placarded **INSTRUMENT INDIRECT LIGHTS, BRT** / **OFF**, located on the overhead control panel. The instrument indirect light circuit is protected by a 5-ampere circuit breaker placarded **INSTR INDIRECT,** located on the right sidewall circuit breaker panel.



1. Tail Floodlights R
2. Upper Strobe Beacon/Anti-collision
3. Tail Navigation Light / Strobe Light
4. Lower Strobe Beacon/Anti-collision
5. Entry Light
6. Wing Navigation Lights / Strobe Lights
7. Recognition Lights
8. Ice lights
9. Landing / Taxi Lights

Figure 2-32. Exterior Lighting

(4) Pilot's Flight Instrument Lights. Illumination of the pilot's flight instruments is controlled by a rheostat switch placarded **PILOT FLIGHT INSTR BRT** / **OFF**, located on the overhead control panel. The pilot's flight instrument light circuit is protected by a 7-1/2-ampere circuit breaker placarded **COPLT FLT INSTR**, located on the right sidewall circuit breaker panel.

(5) Copilot's Flight Instrument Lights. Illumination of the copilot's flight instruments is controlled by a rheostat switch placarded **COPILOT FLIGHT INSTR, BRT / OFF**, located on the overhead control panel. The copilot's flight instrument light circuit is protected by a 7-1/2-ampere circuit breaker placarded **COPLT FLT INSTR**, located on the right side-wall circuit breaker panel.

(6) Avionics Panel Lights. Illumination of the avionics panel is controlled by a rheostat switch placarded **AVIONICS PANEL LIGHTS BRT / OFF**, located on the overhead control panel. The avionics panel light circuit is protected by a 5-ampere circuit breaker placarded **AVIONICS & ENG INSTR**, located on the right sidewall circuit breaker panel.

(7) Engine Instrument Lights. Illumination of the engine instruments is controlled by a rheostat switch placarded **ENGINE INSTRUMENT LIGHTS BRT / OFF**, located on the overhead control panel. The engine instrument light circuit is protected by a 5-ampere circuit breaker placarded **AVIONICS**, **& ENGINE INSTR**, located on the right sidewall circuit breaker panel.

(8) Overhead Control Panel, Subpanels, and Console Lights. Illumination of the overhead control panel, subpanels, and console lights is controlled by a rheostat switch placarded **OVERHEAD SUBPANEL & CONSOLE LIGHTS BRT / OFF**, located on the overhead control panel. The overhead control panel, subpanels, and console lights circuit is protected by a 7-1/2 ampere circuit breaker placarded **SUB PNL OVHD & CONSOLE,** located on the right sidewall circuit breaker panel.

(9) Side Panel Lights. Illumination of the side panels is controlled by a rheostat switch placarded **SIDE PANEL LIGHTS BRT / OFF**, located on the overhead control panel. The side panel light circuit is protected by a 7-1/2-ampere circuit breaker placarded **PLT FLT SIDE PNL** (R) or a 5-ampere circuit breaker placarded **SIDE PANEL** (F3/T3), located on the right sidewall circuit breaker panel.

b. Cabin Lighting*.*

(1) No Smoking / Fasten Seat Belt Light. A switch placarded **NO SMOKE & FSB OFF** / **FSB**, located on the copilot's subpanel controls the **NO SMOKING / FASTEN SEAT BELT** sign in the cabin. The circuit is protected by a 10-ampere circuit breaker placarded **NO SMK FSB & CABIN**, located on the right sidewall circuit breaker panel.

(2) Threshold and Aisle Lights. A threshold light is installed just above floor level on the left side of the cabin, just inside the cabin door. An aisle light is installed at floor level immediately aft of the main spar cover. Both circuits are connected to the emergency battery bus. Both lights are controlled by a switch mounted adjacent to the threshold light. This switch also turns the exterior entry light on and off. If the lights are illuminated, closing the cabin door will automatically extinguish them.

(3) Cabin Door Latching Mechanism Light. A light is provided to check the cabin door latching mechanism. It is controlled by a red push-button switch located adjacent to the round observation window, which is just above the second step.

(4) Emergency Lighting (F3/T3). A D-cell battery operated emergency lighting system is installed within the EXIT sign assemblies. The lights are equipped with an **ON-TEST** and **OFF-RESET** switch but also operate from a 2 – 3G shock switch.

Section XI. FLIGHT INSTRUMENTS

2-75. PITOT SYSTEM.

a. Pitot System R. The pitot system, illustrated in Figure 2-33, provides ram air pressure for the airspeed indicators and air data computer. The pitot system consists of two pitot masts (one located on each side of the lower portion of the nose), and associated plumbing. The pitot masts are protected from ice formation by internal electric heating elements.

b. Pitot System T3 F3 *.* The pitot and static system provides a source of impact air and static air for operation of the flight instruments. A heated pitot mast is located on each side of the lower portion of the nose. Tubing from the left pitot mast is connected to the pilot's airspeed indicator, and tubing from the right pitot mast is connected to the copilot's airspeed indicator.

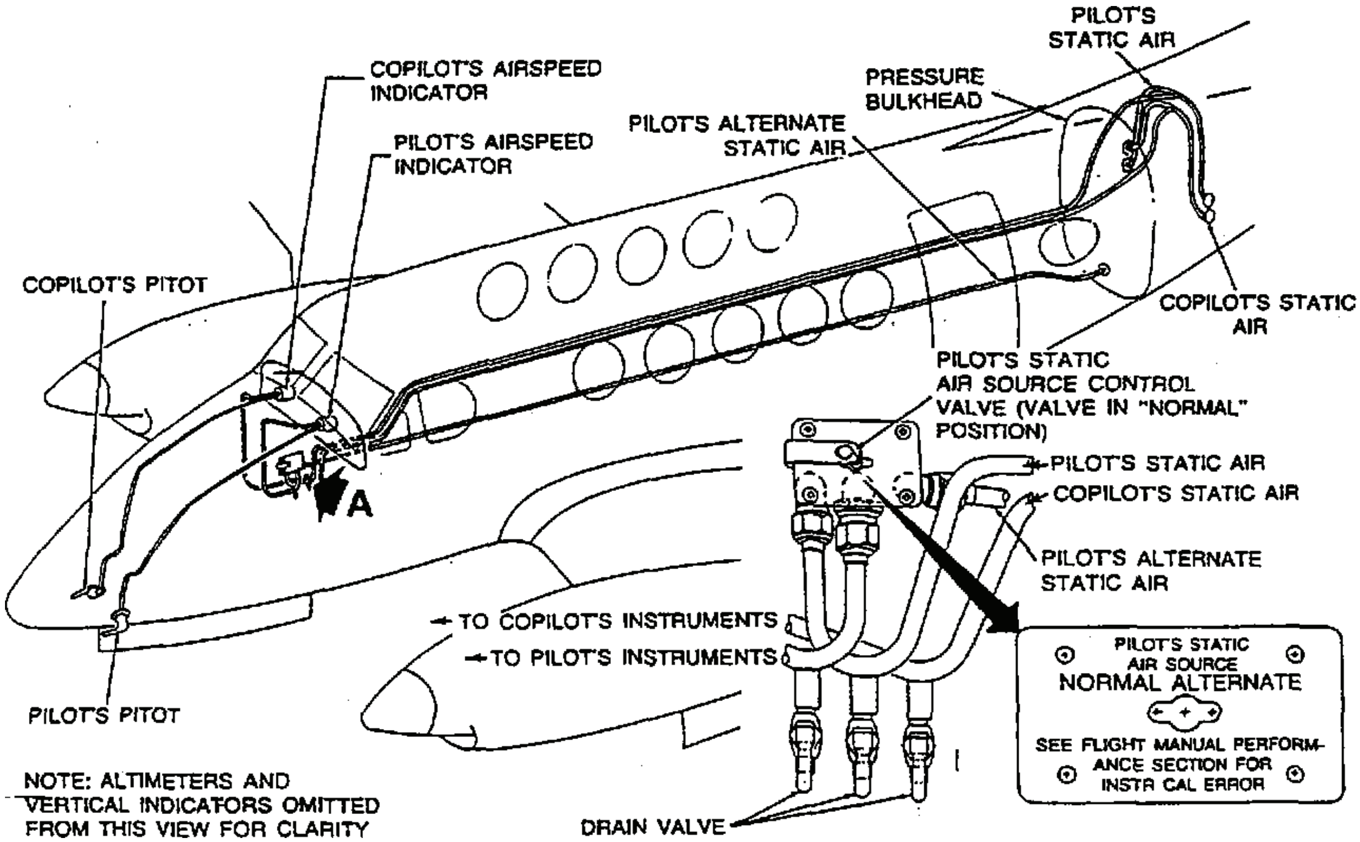


Figure 2-33. Pitot and Static System

2-76. STATIC AIR SYSTEM.

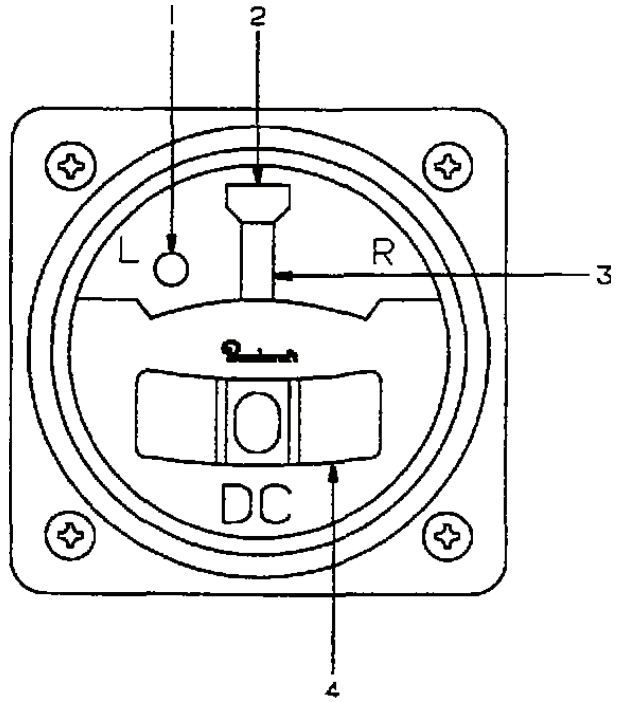
a. Description. The static system, Figure 2-33, provides static air pressure for the pilot's and copilot's airspeed indicators, copilot's altimeter air data computer, and pilot's and copilot's vertical speed indicators. The static air pressure ports are located on the right and left sides of the aft fuselage exterior skin.

b. Alternate Static Air Source. An alternate static airline, which terminates just aft of the rear pressure bulkhead, provides a source of static air for the pilot's instruments in the event of source failure from the pilot's static airline. A control on the right cockpit sidewall, placarded **PILOT'S STATIC AIR SOURCE**, may be actuated to select either the **NORMAL** or **ALTERNATE** air source by a two-position selector valve. The valve is secured in the **NORMAL** position by a spring clip.

2-77. TURN AND SLIP INDICATOR.

a. Description R. The pilot and copilot are each provided with a turn-and-slip indicator as illustrated in Figure 2-34. The turn needles on these instruments indicate the direction and rate of turn. A one needle width deflection indicates a two-minute (180° per minute) turn. Deflection of the inclinometer ball from the center of the inclinometer tube indicates that the aircraft is not in a coordinated turn (that it is either in a slipping or skidding turn, depending on direction of turn). These indicators are gyroscopically operated and electrically powered through two individual 5-ampere circuit breakers placarded **PILOT TURN & SLIP**, and **COPLT TURN & SLIP**, located on the right sidewall circuit breaker panel.

b. Description T3 One turn and slip indicator is installed on the pilot side of the instrument panel. The indicator is gyroscopically operated. The unit is operated by dc power and is protected by a circuit breaker, placarded **PILOT TURN & SLIP**, on the right side circuit breaker panel.



1. **Gyro Warning Indicator**
2. **Rate Of Turn Index**
3. **Rate Of Turn Indicator Needle**
4. **Inclinometer**

Figure 2-34. Turn and Slip Indicator

c. Description F3. Two turn and slip indicators are installed separately on the pilot and copilot sides of the instrument panel. These indicators are gyroscopically operated by dc power and are protected by a circuit breaker placarded **PILOT TURN & SLIP** on the right side circuit breaker panel. The copilot's indicator is a vacuum instrument operated by engine bleed air pressure that is reduced to approximately 2.0 inches Hg. by an inline orifice.

d. Turn and Slip Indicator Controls, Indicators, and Functions.

(1) Gyro Warning Indicator. Presence indicates loss of electrical power to instrument.

(2) Rate of Turn Index. Used in conjunction with the rate of turn indicator needle to show direction and rate of turn.

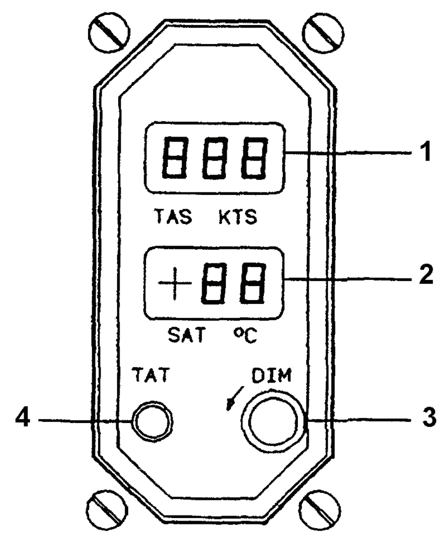
(3) Rate of Turn Indicator Needle. Deflection left or right indicates direction and rate of turn.

(4) Inclinometer. Deflection of the inclinometer ball from the center of the inclinometer tube indicates that the aircraft is in a slipping or skidding turn, depending on turn direction.

2-78. AIRSPEED INDICATORS.

a. Indicated Airspeed. Two identical airspeed indicators are installed separately on the pilot's and copilot's sides of the instrument panel. These indicators require no electrical power for operation. The indicator dials are calibrated in knots from 40 to 300. An aneroid operated striped pointer automatically displays the maximum allowable airspeed at a given aircraft altitude.

b. TAS/TAT Indicator. An electrically heated probe located aft of the nose wheel well sends airspeed and temperature inputs to the air data computer. On the F3, the computer generates this information into Airspeed and Air Temperature data that is displayed on the **TAS** / **TAT** instrument located on the copilot's side of the instrument panel. Icing of the probe is prevented (when airborne), by placing the switch placarded **PROBE HEAT / OFF** to the **PROBE HEAT** (On) position. The probe heater is wired through a squat switch on the right main landing gear, which disables probe heat while the aircraft is on the ground, regardless of the **PROBE HEAT** switch position. Probe heat should be used when the other aircraft anti-icing / deicing systems are activated. The combined Total Airspeed, Static Air Temperature / Total Air Temperature indicator, Figure 2-35, provides a digital display of both **TAS** and **SAT** or **TAT** as generated by the air data computer. Table 2-10 for clarification and explanation of controls and functions.



1. **True Airspeed Indicator**
2. **Static/True Air Temperature Indicator**
3. **Front Panel Dimming Control**
4. **True Air Temperature Push Button**

Figure 2-35. Airspeed Indicator

Table 2-10. Airspeed Indicator

NO.	FUNCTION
1	Displays TAS.
2	Displays SAT in Two digits and 6 sign from – 99 °C to + 50 °C.
3	Dims Front Panel.
4	Momentary push button when pressed changes SAT to TAT.

2-79. STANDBY BAROMETRIC ALTIMETER (R).

a. Description. On the R-model, the standby barometric altimeter, illustrated in Figure 2-36, provides an indication of the aircraft's pressure altitude above sea level.

NOTE

If the altimeter does not read within 70 feet of field elevation, when the correct local barometric setting is used, the altimeter needs calibration or internal failure has occurred. An error of greater than 70 feet also nullifies use of the altimeter for IFR flight.

b. Controls, Indicators, and Functions.

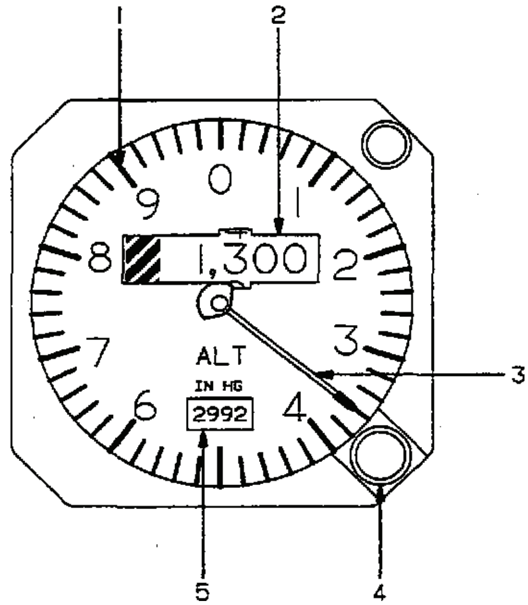
(1) Altitude Scale. Used in conjunction with altitude indicator needle to indicate aircraft altitude in hundreds of feet, subdivided into 20-foot increments.

(2) Counter-Drum Altitude Display. Indicates aircraft altitude in tens of thousands, thousands, and hundreds of feet above sea level.

(3) Altitude Indicator Needle. Used in conjunction with altitude scale to display aircraft altitude in hundreds of feet.

(4) Barometric Pressure Setting Knob. Used to manually set barometric pressure displayed in the **IN HG** display.

(5) Barometric Pressure Display (Inches of Mercury). Indicates the barometric pressure in inches of mercury that has been set by the barometric pressure setting knob.



1. **Altitude Scale**
2. **Counter-Drum Altitude Display**
3. **Altitude Indicator Needle**
4. **Barometric Pressure Setting Knob**
5. **Barometric Pressure Display (Inches of Mercury)**

Figure 2-36. Standby Barometric Altimeter

2-80. ALTIMETERS.

a. Pilot's Servoed Altimeter. The pilot's altimeter provides a servoed counter drum/pointer display of barometrically corrected pressure altitude, derived from the air data computer system. **T3** **F3** For proper operation, the 2 ampere **AIR DATA ENCODER** circuit breaker located in the Avionics section of the right sidewall circuit breaker panel must be set. The altimeter is 26 Vac powered and is protected by the 1 ampere **PILOT ALTM** circuit breaker also located on the right wall panel. **R** For proper operation, the three ampere **AIR DATA** circuit breaker located in the Flight Section of the right side wall circuit breaker panel must be set. The altimeter is 26 Vac powered and is protected by the 1-ampere **PILOT VS ALTM** circuit breaker also located on the right wall panel.

(1) The servoed altimeter provides the following displays:

1. Counter drum display of altitude, in 20 feet increments.

2. Pointer display of altitude between 1000 feet levels in 20-foot graduations.

Altitudes below 10,000 feet are annunciated by a black and white crosshatch on the left digit position of the counter display.

A barometric pressure counter, manually set by the **BARO** knob, displays barometric pressure in inches of mercury (Hg.), and millibars (Mb.), and provides this information to the air data computer. A red warning flag in view indicates the altitude information is unreliable, however the Mode C (altitude reporting) information may be valid.

WARNING

In the event of a total aircraft ac and dc electrical power loss, the warning flag will be in view, the altimeter will be inoperative, and the indicated altitude will remain as existed at the time of failure. A dc power loss only (retains ac power) usually results in the altimeter spooling down toward a lower altitude instead of retaining the altitude at which the power failure occurred.

The altitude alert annunciator (**ALT**), located on the upper bezel, illuminates to provide a visual indication when the aircraft is within 1,000 feet of the pre-selected altitude during the capture maneuver and extinguishes as the aircraft is within 300 ± 50 feet of the pre-selected altitude. After capture, the light will re-illuminate if the aircraft departs more than 300 ± 50 feet from the selected altitude, and extinguish when the aircraft has departed more than 1,000 feet from the selected altitude.

b. Copilot's Pneumatic Altimeter. The copilot's altimeter is a pneumatic instrument equipped with a 28 Vdc internal vibrator. The vibrator is required to overcome friction and assure instrument accuracy. Altitude is displayed on the altimeter by 10,000, 1,000, and 100 foot count drums, and a single-needle pointer which indicates hundreds of feet in 20-foot increments. The barometric pressure setting knob is provided to simultaneously adjust the bare counters display in inches of mercury (Hg.), and millibars (Mb.). Below an altitude of 10,000 feet, a diagonal symbol will appear in the 10,000-foot counter. A circuit breaker, placarded **T3 F3 COPILOT ALTM** and **R COPLT VS & ALTM**, located in the Flight group on the right side circuit breaker panel, protects the vibrator circuit. Refer to Figure 2-6, Sheets 1 through 5.

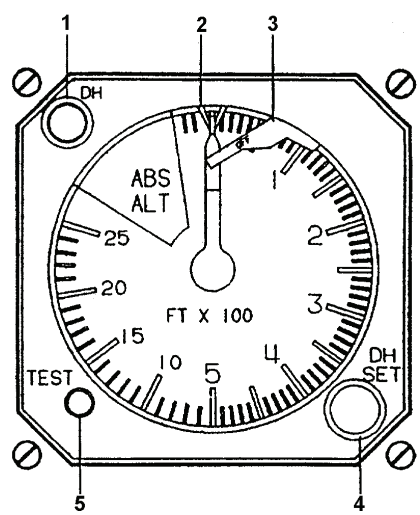
c. Radio Altimeter Indicator F3 . Displays radio altitude information from 2,500 feet to touchdown with an expanded linear scale under 500 feet.

(1) The radio altimeter provides the following displays. Refer to Figure 2-37.

1. Radio Alt Pointer display of radio altitude from 0 to 2,500 feet.
2. Triangular decision height bug, manually set by knob.
3. Annunciator light to alert that aircraft is at or below selected DH.
4. A failure warning flag in view indicates the system information may be unreliable
5. Test button to check indicator R/T unit and flag operation.

Operating the test button causes the flag to come into view and altitude pointer to indicate approximately 100 feet. Release of button causes pointer to return to existing altitude and flag to retract.

The radio altimeter also provides altitude and decision height information to the ground collision avoidance system (GCAS). Setting the radio altimeter decision height marker to a decision height altitude with the **DH SET** knob will cause the GCAS to announce the "Minimums, Minimums" aural warning when the aircraft transitions through the selected DH altitude.

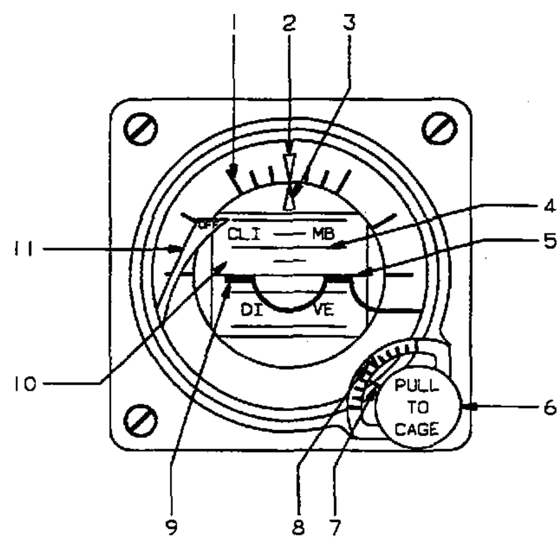


1. Decision Height Annunciator
2. Decision Height Bug
3. Decision Height Flag
4. Decision Height Set Knob
5. Test Push Button

Figure 2-37. Radio Altimeter Indicator F3

2-81. STANDBY ATTITUDE INDICATOR.

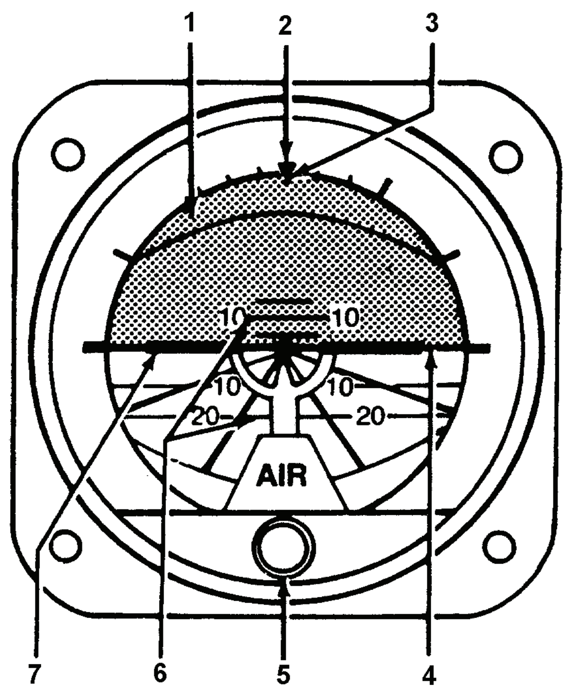
a. Description R. An electrically operated standby attitude indicator, Figure 2-38, with a backup battery system, is located on the pilot's instrument panel, Figure 2-17. The backup battery is located on the bottom shelf on the copilot's side of the nose compartment, and is charged from the aircraft **NO. 3 AVIONICS BUS**. Backup battery protection is provided by a 15-ampere circuit breaker, placarded **STBY BAT**, and the standby attitude indicator is protected by a 2-ampere circuit breaker placarded **HORIZON IND**. Both circuit breakers are located on the right sidewall circuit breaker panel Figure 2-6, Sheet 1 of 5. The standby attitude indicator is capable of providing accurate attitude indications for up to 30 minutes with the backup battery following a total aircraft electrical system failure.



1. **Bank Angle Scale**
2. **Bank Angle Index**
3. **Bank Angle Pointer**
4. **Pitch Angle Scale**
5. **Horizon Line**
6. **Caging and Pitch Trim Knob**
7. **Pitch Trim Pointer**
8. **Pitch Trim Scale**
9. **Miniature Symbolic Aircraft**
10. **Drum**
11. **Power Warning Flag**

Figure 2-38. Standby Attitude Indicator R

b. Description T3. The standby attitude indicator, Figure 2-39, located under the TCAS display on the pilot's instrument panel, is powered by engine bleed air, and provides a visual reference of the aircraft pitch and roll. The attitude indicator is comprised of a self contained gyro to erect the sphere which provides the pitch and roll reference, an indicating symbol which represents the aircraft, and a horizontal line behind the indicating symbol which represents the horizon. The moveable indicating symbol may be adjusted vertically to correct for variations in level flight attitudes by a small knob located on the front base of the indicator. Table 2-11 describes the functions of the controls/indicators.



1. **Attitude Sphere**
2. **Roll Index**
3. **Roll Pointer**
4. **Horizon Line**
5. **Pitch Knob**
6. **Pitch Scale**
7. **Symbolic Miniature Aircraft**

Figure 2-39. Standby Attitude Reference Indicator T3

Table 2-11. Standby Attitude Indicator Control / Functions T3

NO.	FUNCTION
1	Moveable sphere with line between colors to indicate the earth's horizon.
2	Rotates with aircraft to provide measurement of angular displacement by the roll pointer.
3	Indicates vertical in any roll attitude.
4	Indicates earth's horizon relative to aircraft pitch attitude.
5	Rotated to adjust the miniature aircraft.
6	Measures pitch displacement of miniature aircraft.
7	Represents aircraft nose and wings. Indicates roll and pitch attitude relative to the horizon. Adjustable through pitch knob for varying pitch attitudes.

c. Description F3 OSA . The standby attitude reference system, Figure 2-40, is comprised of the attitude indicator located on the extreme left center of the pilot's instrument panel and a 28 Vdc emergency power supply. They provide a visual indication of the aircraft flight attitude. The attitude reference system is designed to provide a standby attitude indicator that is powered by a source independent of the aircraft electrical generating system. The system will provide reliable attitude information for at least 30 minutes after a total failure of the aircraft electrical system. The power supply contains sealed lead-acid batteries with a rating of 5.0 ampere hours. During normal operation, the aircraft 28 Vdc system supplies power to the indicator and power supply batteries. In the event aircraft electrical power fails, the standby power supply will take over the duties of powering the attitude indicator.

The attitude indicator is a 28 Vdc powered electrically driven gyro and contains an inverter circuit board for converting the 28 Vdc input to 22 Vac 400 Hz for indicator operation. The power warning flag is rotated out of sight by a flag motor that allows the flag to appear if one or more phases of power are interrupted. The flag motor also allows the flag to appear if the **PULL TO CAGE** knob is in the caged position. The rotor speed and the mechanical erection system enables the indicator to provide a minimum of 9 minutes of useful attitude information after complete electrical power interruption.

A three-position switch and a three legend annunciator unit located below the indicator provide system control, test and visual indication of the system status. The three position switch, placarded **ON / OFF / TEST** (normally **OFF**), provides control and test capabilities of the battery powered system. While in the normal **OFF** position, the annunciator, placarded **AUX ARM**, will be illuminated indicating the system batteries are being maintained in a charged condition and the system is in a standby (non-active) mode. In the **TEST** position, a check of the battery pack illuminates the **AUX TEST** annunciator.

Placed in the **ON** position, it activates the Standby Horizon Indicator system and illuminates the **AUX ON** annunciator, provided the system circuit breaker is set.

Table 2-12 describes the functions of the controls/indicators.

d. Standby Attitude Indicator Controls, Indicators, and Functions.

(1) Bank Angle Scale. Used in conjunction with bank angle pointer to indicate aircraft bank angle.

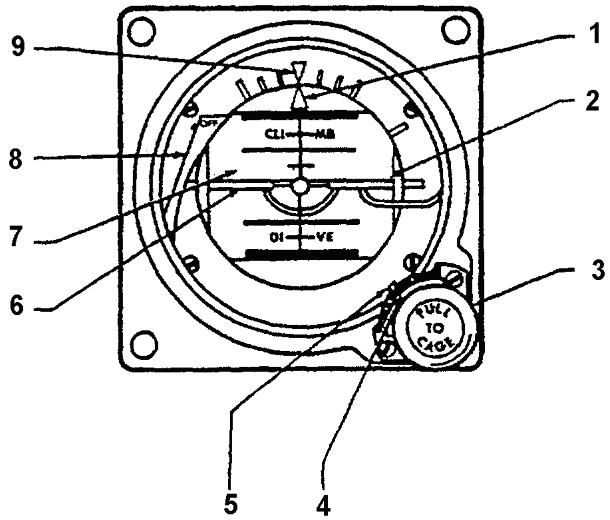
(2) Bank Angle Index. Rotates with aircraft to provide measurement of angular displacement by roll pointer during maneuvers.

(3) Bank Angle Pointer. The moveable bank angle pointer indicates aircraft bank angle by moving around a fixed bank angle scale.

(4) Pitch Angle Scale. Aircraft pitch angle may be read under the symbolic miniature aircraft on a vertical pitch angle scale located on the attitude drum.

(5) Horizon Line. The horizon line displays aircraft pitch and roll attitude with respect to the earth's horizon.

(6) Caging and Pitch Trim Adjustment Knob. This knob, placarded **PULL TO CAGE**, is used to vertically adjust the symbolic miniature aircraft for changes in the aircraft's level flight pitch attitude and to cage the instrument.



1. Roll Pointer
2. Horizon Line
3. Caging / Pitch Trim Knob
4. Trim Pointer
5. Pitch Trim Scale
6. Miniature Aircraft
7. Drum
8. Power Warning Flag
9. Roll Index

Figure 2-40. Standby Attitude Indicator F3 OSA

Table 2-12. Standby Attitude Indicator Control / Functions F3 OSA

NO.	FUNCTION
1	Indicates vertical in any roll attitude.
2	Indicates earth's horizon relative to aircraft pitch attitude.
3	Pulled to cage the indicator and rotated to adjust the miniature aircraft attitude.
4	Pointer indicates trim displacement.
5	Measures displacement of miniature aircraft.
6	Represents aircraft nose and wings. Indicates roll and pitch attitude relative to the horizon. Adjustable through pitch knob for varying pitch attitudes.
7	Directly linked to the spin motor to provide direct reading of aircraft movement in roll and pitch. Marked each 5° in pitch. Black area of drum indicates dive; blue or gray area indicates climb.
8	In view, indicates power off, caged condition, open motor winding, or loss of power. Retracted, normal operation.
9	Rotates with aircraft to provide measurement of angular displacement by the roll pointer during maneuvers.

(7) Pitch Trim Pointer. Indicates amount of vertical trim displacement applied to the miniature aircraft.

(8) Pitch Trim Scale. Provides a means of measuring the amount of vertical trim displacement applied to the miniature aircraft.

(9) Miniature Symbolic Aircraft. The relationship between the fixed miniature aircraft symbol and the movable attitude sphere display aircraft pitch and roll attitudes.

(10) Drum. The drum is directly linked to the gyro to provide a direct measurement of aircraft movement around the pitch and roll axis.

(11) Power Warning Flag. Presence of the power warning flag indicates no power to the unit, a caged condition, or open gyro motor winding.

e. Standby Attitude Indicator Backup Battery Power System Controls, Indicators, and Functions. R The controls and indicators for the standby attitude indicator backup battery power system are located on the audio control panel. Refer to Figure 3A-1.

F3 The controls and indicators for the standby attitude indicator back up battery power system are located on the audio control panel.

(1) Standby Horizon Power Warning Horn Silence Switch. The standby horizon power warning horn may be silenced by pressing a push-button switch placarded **HORN SILENCE** **R**.

(2) Standby Horizon Power Control Switch. A switch placarded **ON / OFF / TEST** controls the standby horizon power system.

(3) Standby Horizon Power Annunciator. The standby horizon power system annunciator, placarded **AUX ARM / AUX ON / AUX TEST**, is used to monitor functional state of the system.

2-82. FREE AIR TEMPERATURE (FAT) GAUGE R.

A digital free air temperature gauge is located on the left cockpit sidewall. Temperature is normally displayed in °C, but pressing a push-button switch placarded **PUSH FOR °F** will change the display to degrees Fahrenheit.

2-83. STANDBY MAGNETIC COMPASS.

WARNING

Inaccurate indications on the standby magnetic compass will occur while windshield heat, air conditioning, or EFIS are being used or the sun visors are in the front position.

The standby magnetic compass, located below the overhead control panel, Figure 2-31, is used in the event of failure of the compass system, and for instrument cross check. Readings should be taken only during level flight since turning or acceleration may introduce errors. A compass correction chart, indicating deviation factors, is located on the magnetic compass.

2-84. VERTICAL SPEED INDICATORS.

a. Description **R**. The vertical speed indicators are incorporated on both pilot and copilot's altitude/vertical speed indicators. The face is placarded **VERTICAL SPEED UP / DOWN**. The range of the instrument is from 0 to 6,000 feet per minute, the first 1,000 feet graduated in 100 fpm increments.

b. Description **T3**. The pilot's VSI is incorporated into the TVSI TCAS II indicator. The range of the instrument is from 0 to 6,000 feet per minute, with the first 1,000 feet graduated in 100 fpm increments and the remainder in 500 fpm increments. The copilot's VSI is placarded **VERTICAL SPEED UP / DOWN**, The range of the instrument is from 0 to 3,000 feet per minute, the first 1,000 feet is graduated into 100 fpm increments. The remainder is graduated in 500 fpm.

c. Description **F3**. The vertical speed indicators are mounted on both sides of the instrument panel. The face is placarded **VERTICAL SPEED UP / DOWN**. The range of the instrument is for 0 to 4,000 feet per minute, with the first 2,000 feet graduated in 100 fpm increments and the remainder in 250 fpm increments.

2-85. MISCELLANEOUS INSTRUMENTS.

a. Warning Annunciator Panel. The warning annunciator panel, Figure 2-41, located near the center of the instrument panel in the glareshield, contains red fault annunciators. Illumination of a red fault annunciator signifies the existence of a hazardous condition requiring pilot attention. Table 2-13 lists the red fault annunciators, and the causes for their illumination.

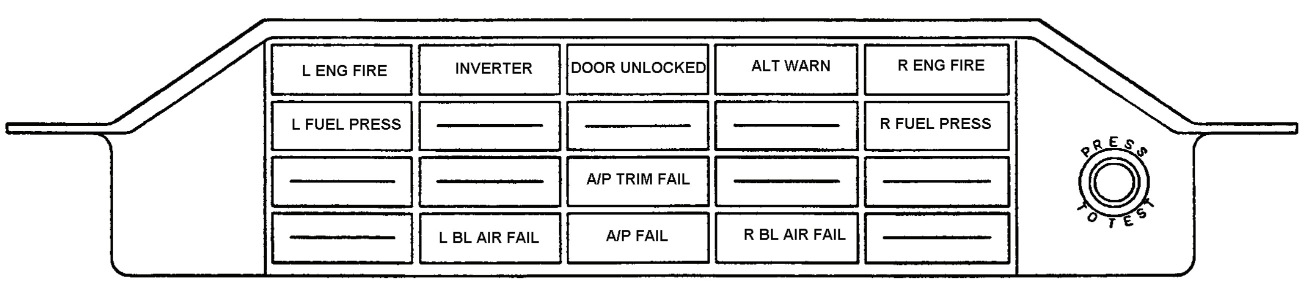


Figure 2-41. Warning Annunciator Panel R (Sheet 1 of 2)

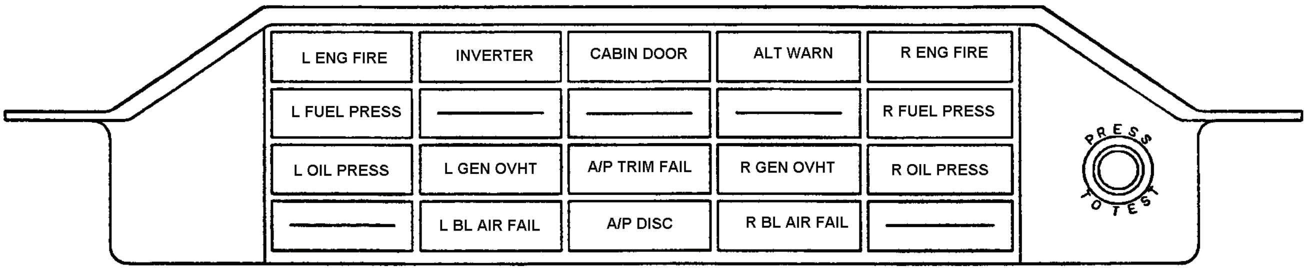


Figure 2-41. Warning Annunciator Panel T3 F3 (Sheet 2 of 2)

Table 2-13. Warning Annunciator Panel Legend

WARNING ANNUNCIATOR		
NOMENCLATURE	**COLOR**	**CAUSE FOR ILLUMINATION**
L ENG FIRE	Red	Left engine fire detected.
INVERTER	Red	Inverter inoperative.
DOOR UNLOCKED R	Red	Cabin / cargo door open or not secure.
CABIN DOOR T3 F3	Red	Cabin / cargo door open or not secure.
ALT WARN	Red	Cabin altitude exceeds 12,500 feet.
R ENG FIRE	Red	Right engine fire detected.
L FUEL PRESS	Red	Fuel pressure failure on left side.
R FUEL PRESS	Red	Fuel pressure failure on right side.
L OIL PRESS T3 F3	Red	Low oil pressure left engine.
L GEN OVHT T3 F3	Red	Left generator temperature too high.
A / P TRIM FAIL	Red	Autopilot trim failed.
R GEN OVHT T3 F3	Red	Right generator temperature too high.
R OIL PRESS T3 F3	Red	Low oil pressure right engine.
L BL AIR FAIL	Red	Left bleed air warning line has melted or failed, indicating possible leak of left engine bleed air.
A / P FAIL R	Red	Autopilot has failed.
A / P DISC T3 F3	Red	Autopilot has disconnected.
R BL AIR FAIL	Red	Right bleed air warning line has melted or failed, indicating possible leak of right engine bleed air.

b. Caution/Advisory Annunciator Panel. The caution/advisory annunciator panel, Figure 2-42, located on the center subpanel, contains the caution/advisory annunciators. The yellow caution annunciators signify a condition requiring pilot attention. A green advisory annunciator indicates a functional condition. Table 2-14 lists the caution/ advisory annunciators and causes for illumination.

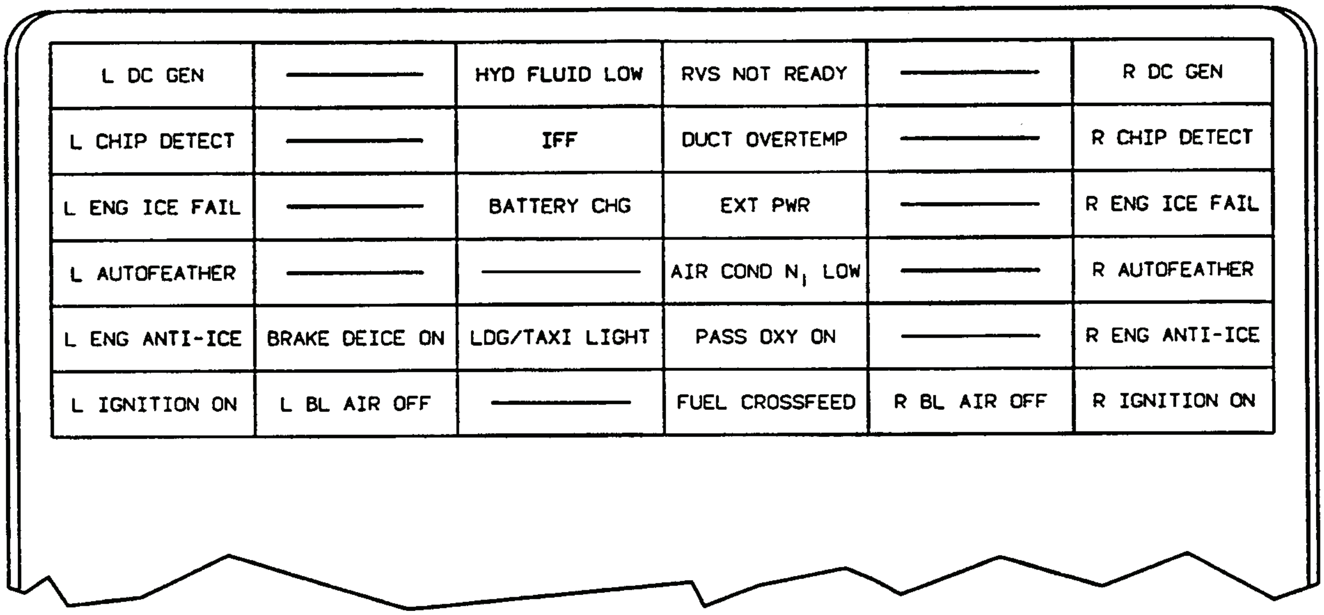


Figure 2-42. Caution / Advisory Annunciator Panel **R** *(Sheet 1 of 2)*

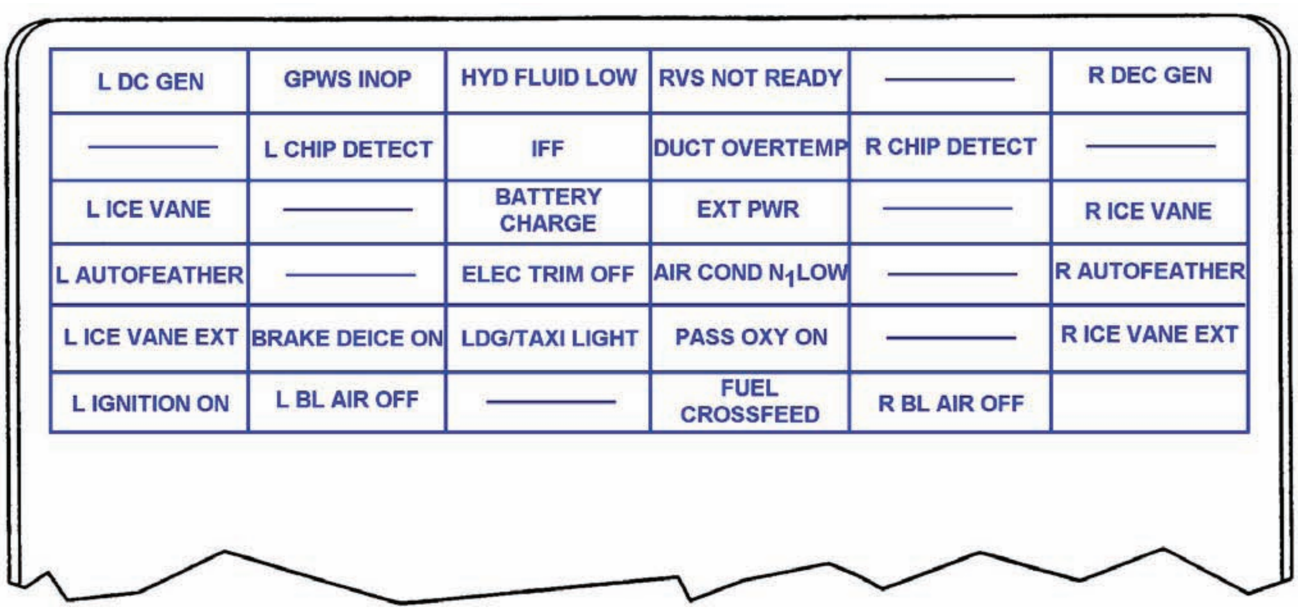


Figure 2-42. Caution / Advisory Annunciator Panel **T3** **F3** *(Sheet 2 of 2)*

Table 2-14. Caution / Advisory Annunciator Panel Description

CAUTION / ADVISORY ANNUNCIATOR		
NOMENCLATURE	COLOR	CAUSE FOR ILLUMINATION
L DC GEN	Yellow	Left engine generator off the line.
GPWS INOP T3 F3	Yellow	Ground Collision Avoidance System not functional.
HYD FLUID LOW	Yellow	Fluid level in power pack is low.
RVS NOT READY	Yellow	Propeller levers are not in the high RPM, low pitch position, with the landing gear extended.
R DC GEN	Yellow	Right engine generator off the line.
L CHIP DETECT	Yellow	Contamination of left engine oil detected.
IFF	Yellow	Transponder fails to reply to a valid mode 4 interrogation.
DUCT OVERTEMP	Yellow	Excessive bleed air temperature in environmental heat ducts.
R CHIP DETECT	Yellow	Contamination of right engine oil detected.
L ENG ICE FAIL R	Yellow	Left engine ice vane malfunction. Ice vane has not attained proper position.
L ICE VANE T3 F3	Yellow	Vane did not attain selected position within 15 seconds.
BATTERY CHG	Yellow	Charge rate on battery exceeds 7 amperes.
EXT PWR	Yellow	External power connector plugged in.
R ENG ICE FAIL R	Yellow	Right engine ice vane malfunction. Ice vane has not attained proper position.
R ICE VANE T3 F3	Yellow	Vane did not attain selected position within 15 seconds.
L AUTOFEATHER	Green	Left autofeather armed.
L ICE VANE EXT T3 F3	Green	Ice vane is in extended position.
ELEC TRIM OFF T3 F3	Green	Electric trim switch has been turned off.
AIR COND N_1 LOW	Green	Right engine RPM too low for air conditioning load.
R AUTOFEATHER	Green	Right autofeather armed.
L ENG ANTI-ICE R	Green	Left ice vane extended.
L ICE VANE EXT T3 F3	Green	Left ice vane is in extended position.
BRAKE DEICE ON	Green	Brake deicing system is on.
LDG / TAXI LIGHT	Green	Landing / taxi light is selected on with the landing gear retracted.
PASS OXY ON	Green	Passenger oxygen system is operating.
R ENG ANTI-ICE R	Green	Right ice vane extended.
R ICE VANE EXT T3 F3	Green	Ice vane is in extended position.
L IGNITION ON	Green	Left engine ignition / start switch on, left engine auto-ignition switch armed and engine torque below 20%.
L BL AIR OFF	Green	Left environmental bleed air valve closed.
FUEL CROSSFEED	Green	Crossfeed valve open.
R BL AIR OFF	Green	Right environmental bleed air valve closed.

Table 2-14. Caution / Advisory Annunciator Panel Description (Continued)

CAUTION / ADVISORY ANNUNCIATOR		
NOMENCLATURE	**COLOR**	**CAUSE FOR ILLUMINATION**
R IGNITION ON	Green	Right engine ignition / start switch on, right engine auto-ignition switch armed and engine torque below 20%.

c. Annunciator System – General. In the frontal view, the annunciator panels present rows of small opaque rectangular annunciators. Word printing on the respective indicator identifies the monitored function, situation, or fault condition, but it cannot be read until the annunciator is illuminated. Blank annunciators (no word printing) are non-functioning annunciators. The bulbs of all annunciator panels are tested by pressing the annunciator test push-button switch, placarded **PRESS TO TEST**, located on the instrument panel on the right side of the warning annunciator panel. The system is protected by a 7-1/2-ampere circuit breaker, placarded **ANN POWER**, and a 5-ampere circuit breaker, placarded **ANN IND**, located on the right sidewall circuit breaker panel. The annunciators are dimmed when the **MASTER** light switch is **ON** and the pilot's flight instrument lights are illuminated.

(1) Annunciator Bright and Dim Mode. The caution panels and master caution annunciators feature a bright and dim mode of operation; also, on the R-model, the warning and master warning annunciators. The dim mode will be selected automatically whenever all the following conditions have been met.

1. A generator is on line.
2. Overhead floodlights are **OFF**.
3. Pilot flight instrument lights are on, and Master Panel Lights On (F3/T3).
4. The ambient light intensity in the cockpit (as sensed by a photocell located on the overhead control panel) is below a preset value.

Unless all of these conditions are met, the bright mode will be selected automatically.

d. Master Warning Annunciators (Red). Two **MASTER WARNING** annunciators, one located on each side of the glareshield, are provided to alert the crew of a hazardous condition. Any time a warning annunciator illuminates, the **MASTER WARNING** annunciators will flash, and will remain flashing until reset. If a new condition occurs, the annunciators will be reactivated, and the applicable annunciator panel annunciator(s) will illuminate.

e. Master Caution Annunciators (Yellow). Two **MASTER CAUTION** annunciators, one located on each side of the glareshield adjacent to the **MASTER WARNING** annunciator, Figure 2-41, are provided to alert the crew of a situation requiring the crew's attention. Whenever a caution annunciator illuminates, the **MASTER CAUTION** annunciators will flash, and remain flashing until the **MASTER CAUTION** annunciator is reset. If a new condition occurs, the annunciators will be reactivated and the appropriate annunciator(s) will illuminate.

f. Clocks.

(1) Description. A digital quartz chronometer is mounted in the center of each control wheel, Figure 2-22. Each quartz chronometer is a three-function clock/timer that is controlled by two push-button switches, placarded **SELECT** and **CONTROL**, located directly below the four-digit liquid crystal display.

(2) Operation. The **SELECT** button is pressed to select the desired mode of operation. The mode annunciator is displayed on the left side of the mode identifiers, and advances to indicate each of the following modes:

UT – Universal or Greenwich Mean Time
LC – Local Time
ET – Elapsed Time

Section XII. SERVICING, PARKING, AND MOORING

2-86. GENERAL.

The following paragraphs include the procedures necessary to service the aircraft except lubrication. The lubrication requirements of the aircraft are covered in the aircraft maintenance manual. Tables 2-15, 2-16, 2-17, and 2-18 are used for identification of fuel, oil, etc., used to service the aircraft. The servicing instructions provide procedures and precautions necessary to service the aircraft. Figure 2-43 shows servicing location points.

1. Drain water from fuel tanks, filter cases, and pumps prior to first flight of the day. Preheat, when required, to ensure free fuel drainage.

2. Avoid dragging the fueling hose where it can damage the soft, flexible surface of the deice boots.

3. Observe **NO SMOKING** precautions.

4. Prior to transferring fuel, ensure that the hose is grounded to the aircraft.

5. Wash off spilled fuel immediately.

6. Handle the fuel hose and nozzle cautiously to avoid damaging the wing skin.

7. Do not conduct fueling operations within 100 feet of energized airborne radar equipment or within 300 feet of energized ground radar equipment installations.

8. Wear only non-sparking shoes near aircraft or fueling equipment, as shoes with nailed soles or metal heel plates can be a source of sparks.

Table 2-15. Approved Military Fuels, Oil, Fluids, and Unit Capacities

SYSTEM	SPECIFICATION	CAPACITY
Fuel	MIL-T-83133(JP-8)	544 U.S. Gal Usable
Engine Oil	MIL-L-23699	14 U.S. Quarts per engine
Hydraulic Brake System	MIL-H-5606	1 U.S. Pint
Hydraulic Landing Gear Reservoir	MIL-H-5606	8 U.S. Quarts
Oxygen System	MIL-O-27210	77 Cubic Feet
Toilet Chemical	Monogram DG-19	3 Ounces

Table 2-16. Approved Fuels

SOURCE	PRIMARY OR STANDARD FUEL	ALTERNATE FUEL	
US MILITARY FUEL NATO Code No.	**JP-8 (MIL-T-83133) NATO F-34**	**JP-5 (MIL-T-5624) NATO F-44 (High Flash Type)**	**JP-4 (MIL-T-5624 NATO F-40 (Wide Cut Type)**
COMMERCIAL FUEL	JET A-1	JET A	JET B
(ASTM-D-1655)			
American Oil Co.	American Jet Fuel Type A-1	American Jet Fuel Type A	
Atlantic Refining Co.	Arcojet A-1	Arcojet A	Arcojet B
B.P. Trading Co.	BP A.T.K.		BP A.T.G.
Caltex Petroleum Corp.	Caltex Jet A-1		Caltex Jet-B
Cities Service Co.		Turbine Type A	
Continental Oil Co.	Conoco Jet-60	Conoco Jet-50	Conoco Jet JP-4
EXXON Co. USA	EXXON Turbo Fuel 1-A	EXXON Turbo Fuel A	EXXON Turbo Fuel 4
Gulf Oil	Gulf Jet A-1	Gulf Jet A	Gulf Jet B
Mobil Oil	Mobil Jet A-1	Mobil Jet A	Mobil Jet B
Phillips Petroleum		Philjet A-50	Philjet JP-4
Pure Oil Co.	Purejet Turbine Fuel Type A-1	Purejet Turbine Fuel Type A	

Table 2-16. Approved Fuels (Continued)

SOURCE	PRIMARY OR STANDARD FUEL	ALTERNATE FUEL	
US MILITARY FUEL NATO Code No.	**JP-8 (MIL-T-83133) NATO F-34**	**JP-5 (MIL-T-5624) NATO F-44 (High Flash Type)**	**JP-4 (MIL-T-5624 NATO F-40 (Wide Cut Type)**
Richfield Oil Co.	Richfield Turbine Fuel A-1	Richfield Turbine Fuel A	
Shell Oil	Aeroshell Turbine Fuel 650	Aeroshell Turbine Fuel 640	Aeroshell Turbine Fuel JP-4
Sinclair	Superjet Fuel A-1	Superjet Fuel A	
Standard Oil Co. of California	Chevron TF-1		Chevron JP-4
Standard Oil Co. of Ohio	Jet A-1 Kerosene	Jet A Kerosene	
Standard Oil Co. of Kentucky	Standard JF A-1	Standard JF A	Standard JF B
Texaco	Avjet K-58	Avjet K-40	Avjet JP-4
Union Oil	76 Turbine Fuel		Union JP-4
FOREIGN FUEL		NATO F-44	NATO F-40
Belgium			BA-PF-2B
Canada	CAN/CGSB 3.23/Jet A-1	3-6P-24e	3GP-22F
Denmark			JP-4 MIL-T-5624
France			AIR 3407A
Germany		UTL-9130-007/UTL9130-010	VTL-9130-006
Greece			JP-4 MIL-T-5624
Italy		AMC-143	AA-M-C-1421
Netherlands		D. Eng RD 2493	JP-4 MIL-T-5624
Norway			JP-4 MIL-T-5624
Portugal			JP-4 MIL-T—5624
Turkey			JP-4 MIL-T-5624
United Kingdom (Britain)	D. Eng RD 2494	D. Eng RD 2498	D. Eng RD 2454

NOTE

Anti-icing and Biocidal Additive for Commercial Turbine Engine Fuel – The fuel system icing inhibitor shall conform to MIL-L-27686. The additive provides anti-icing protection and also functions as a biocide to kill microbial growths in aircraft fuel systems. Icing inhibitor conforming to MIL-L-27686 shall be added to commercial fuel, not containing an icing inhibitor, during refueling operations, regardless of ambient temperatures. Refueling operations shall be accomplished in accordance with accepted procedures.

Table 2-17. Standard, Alternate, and Emergency Fuels

ENGINE	ARMY STANDARD FUEL	ALTERNATE TYPE	EMERGENCY FUEL	
			TYPE	*MAX HOURS
PT6A	MIL-T-83133 Grade JP-8	MIL-T-5624 Grade JP-4/5 MIL-T-5624 Grade JP-4	MIL-G-5572 Any AV Gas	150

* Maximum operating hours with indicated fuel between engine overhauls (TBO).

Table 2-18. Recommended Fluid Dilution Chart

AMBIENT TEMPERATURE (°F)	PERCENT DEFROSTING FLUID BY VOLUME	PERCENT WATER BY VOLUME	FREEZING POINT OF MIXTURE (°F) (APPROXIMATE)
30º and above	20	80	10º
20º	30	70	0º
10º	40	60	-15º
0º	45	55	-25º
-10º	50	50	-35º
-20º	55 – 60	45	-45º
-30º	60	40	-55º
1. Use anti-icing and deicing fluid (MIL-A-8243 or commercial fluids). 2. Heat Mixture to a temperature of 82º to 93 ºC (180º to 200 ºF).			

2-87. FILLING FUEL TANKS.

WARNING

Prior to removing the fuel tank filler cap, attach the hose nozzle static ground wire to the grounding sockets located adjacent to the filler opening.

CAUTION

Do not fill the auxiliary fuel tanks unless outboard main tanks are full.

Only fill ferry fuel tanks after the aircraft main and auxiliary tanks are full.

Fill tanks as follows:

1. Attach bonding cables to aircraft.
2. Attach bonding cable from hose nozzle to ground socket adjacent to fuel tank being filled.

CAUTION

Do not insert fuel nozzle completely into fuel cell due to possible damage to bottom of fuel cell. Nozzle should be supported and inserted straight down to prevent damage to the anti-siphon valve.

3. Remove fuel tank filler cap and fill main tank before filling corresponding auxiliary tanks.
4. Secure applicable fuel tank filler cap. Make sure latch tab on cap is pointed aft.
5. Disconnect bonding cables from aircraft.

2-88. DRAINING MOISTURE FROM FUEL SYSTEM.

Twelve fuel drains are installed (plus one drain for the ferry fuel system, when installed) to remove sediment from the fuel system. Two drain lines are included with the ferry fuel tanks to drain off moisture from the tanks.

2-89. FUEL TYPES.

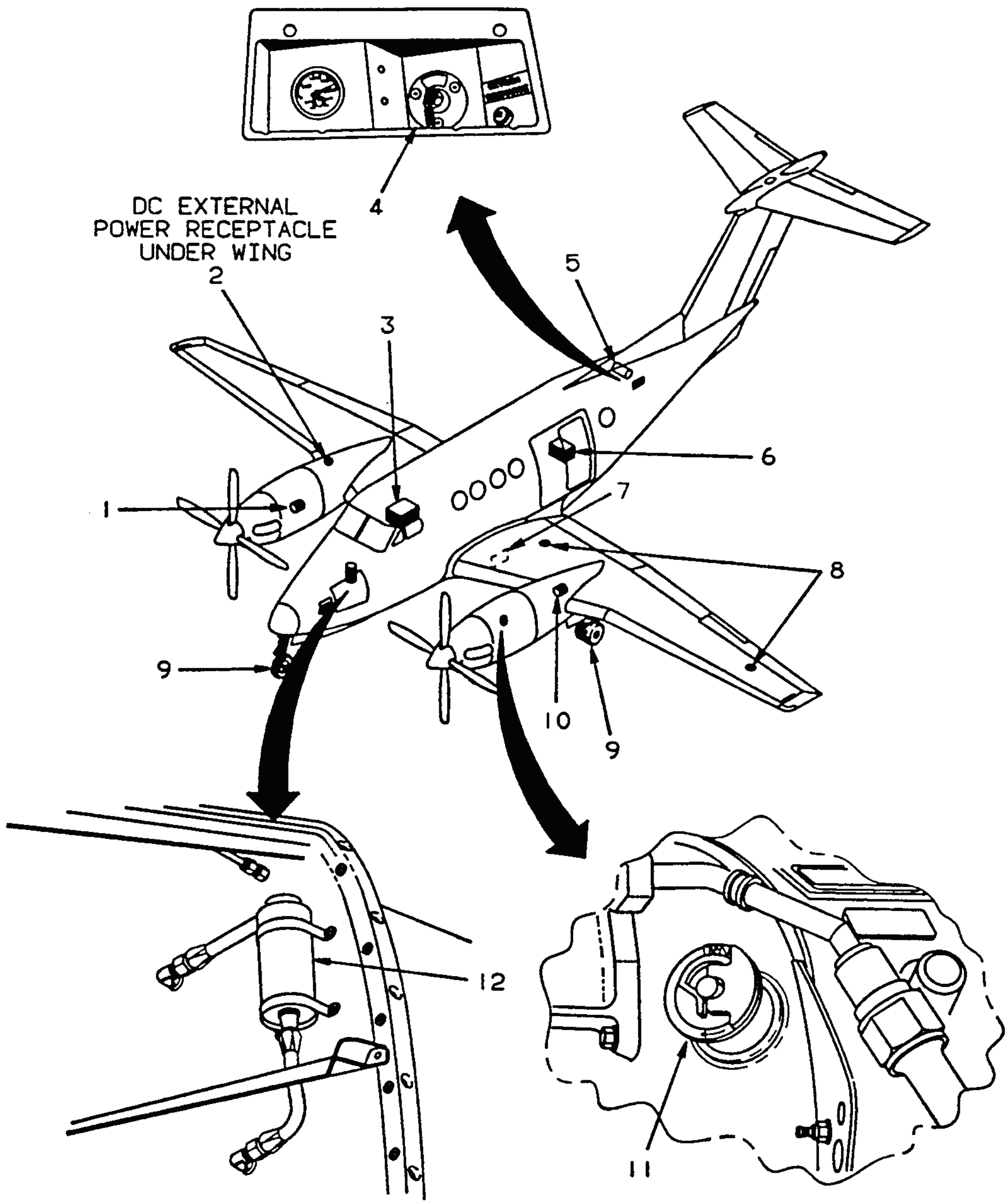
a. Approved Fuel Types*.* Approved fuel types are as follows:

1. *Army Standard Fuels*. Army standard fuel is JP-8.
2. *Alternate Fuels*. Army alternate fuels are JP-4 and JP-5.
3. *Commercial Standard and Alternate Fuels*. Refer to Table 2-16.
4. *Emergency Fuel*. AVGAS is an emergency fuel and subject to a 150-hour time limit.

2-90. USE OF FUELS.

a. Fuel Usage*.* Fuel is used as follows:

(1) Fuel limitations. Fuel limitations are outlined in Chapter 5. For the purpose of recording, fuel mixtures shall be identified as to the major component of the mixture, except when the mixture contains leaded gasoline. The use of any fuels other than standard will be entered in the FAULTS/ REMARKS column of DA Form 2408-13-1, Aircraft Maintenance and Inspection Record, noting the type of fuel, additives, and duration of operation.



1. Air Conditioning Compressor
2. DC External Power Receptacle
3. Battery 24 Vdc
4. Oxygen System Filler
5. Oxygen Cylinder (77 Cu Ft Bottle)
6. Chemical Toilet
7. Landing Gear Hydraulic Reservoir
8. Fuel Filler Caps (Typical Left and Right)
9. Landing Gear Tires (Typical Left, Right, and Nose Gear)
10. Engine Fire Extinguisher (Typical Left and Right) //R-model
11. Engine Oil Filler Cap (Typical Left and Right)
12. Wheel Brake Fluid Reservoir

Figure 2-43. Servicing Locations

(2) Use of Kerosene Fuels. The use of kerosene fuels (JP-5 type) in turbine engines dictates the need for observance of special precautions. Both ground starts and air restarts at low temperature may be more difficult due to low vapor pressure. Kerosene fuels having a freezing point of –40 C (-40 °F), limit the maximum altitude of a mission to 28,000 feet under standard day conditions.

(3) Mixing of Fuels in Aircraft Tanks. When changing from one type of authorized fuel to another, for example JP-8 to JP-5, it is not necessary to drain the aircraft fuel system before adding the new fuel.

(4) Fuel Specifications. Fuels having the same NATO code number are interchangeable. Jet fuels conforming to ASTM D-1655 specification may be used when MIL-T-83133 fuels are not available. This usually occurs during cross-country flights where aircraft using NATO F-34 (JP-8) are refueling with NATO F-40 (JP-4) or commercial ASTM type B fuels. Whenever this condition occurs, the engine operating characteristics may change in that lower operating temperature, slower acceleration, lower engine speed, easier starting, and shorter range may be experienced. The reverse is true when changing from F-40 (JP-4) fuel to F-34 (JP-8) or Commercial ASTM Type A-l fuels. Most commercial turbine engines will operate satisfactorily on either kerosene or JP-4 type fuel. The difference in specific gravity may possibly require fuel control adjustments; if so, the recommendations of the manufacturers of the engine and airframe are to be followed.

2-91. SERVICING OIL SYSTEM.

An integral oil tank occupies the cavity formed between the accessory gearbox housing and the compressor inlet case on the engine. The tank has a calibrated oil dipstick and an oil drain plug. Avoid spilling oil. Any oil spilled must be removed immediately. Use a cloth moistened in solvent to remove oil. Overfilling may cause a discharge of oil through the accessory gearbox breather during engine operation, until a satisfactory level is reached. Service oil system as follows:

1. Open access door on upper cowling to gain access to oil filler cap and dipstick.

CAUTION

A cold oil check is unreliable. If possible, check oil within 10 minutes after engine shutdown. If over 10 minutes have elapsed, motor the engine for 40 seconds, then check. If over 10 hours have elapsed, start the engine and run for 2 minutes, then check. Add oil as required. Do not overfill.

2. If oil level is over 2 quarts low, motor or run engine as required, and service as necessary.

3. Remove oil filler cap.

4. Insert clean funnel, with screen incorporated, into filler neck.

5. Replenish with oil to within 1 quart below MAX mark or MAX COLD on dipstick (cold engine). Fill to MAX or MAX HOT (hot engine).

CAUTION

Ensure that oil filler cap is correctly installed and securely locked to prevent loss of oil and possible engine failure.

6. Check oil filler cap for damage, general condition and the locking mechanism.

7. Install and secure oil filler cap.

8. Check for any oil leaks.

2-92. SERVICING THE HYDRAULIC SYSTEM.

a. Servicing Hydraulic Brake System Reservoir.

1. Gain access to brake hydraulic system reservoir.

2. Remove brake reservoir cap and fill reservoir to washer on dipstick with hydraulic fluid.

3. Install brake reservoir cap.

b. Servicing Hydraulic Landing Gear System. Servicing the hydraulic landing gear extension/ retraction system consists of maintaining the correct fluid level and maintaining the correct accumulator pre-charge. The accumulator is located in the reservoir access area and is charged to 800 ± 50 psi using bottled nitrogen. A charging gauge is mounted on the accumulator. A reservoir, located just inboard of the left nacelle and forward of the main spar, has a lid with a dipstick attached marked **FLUID TEMP 0 °F, 50 °F, I00 °F**. Add MIL-H-5606 hydraulic fluid (consumable materials list) as required to fill the system, corrected for temperature.

2-93. INFLATING TIRES.

Inflate nose wheel tires to a pressure between 55 and 60 psi. Inflate main wheel tires to a pressure between 94 and 98 psi for standard tires or 60 and 64 psi for high flotation tires.

2-94. SERVICING THE CHEMICAL AND ELECTRICAL TOILET.

The toilet should be serviced during routine ground maintenance of the aircraft following every usage. The waste storage container should be removed, emptied, its disposable plastic liner replaced, and the container replaced in the toilet cabinet. Toilet paper, waste container plastic liners, and dry chemical deodorant packets should also be re-supplied within the toilet cabinet as needed.

2-95. SERVICING THE AIR CONDITIONING SYSTEM.

Servicing the air conditioning system consists of checking and maintaining the correct refrigerant level, compressor oil level, belt tension and condition, system leak detection, and replacement of the evaporator air filters. It is imperative that only qualified refrigerant system technicians accomplish maintenance of the air conditioning system, except for filter replacement.

2-96. ANTI-ICING, DEICING, AND DEFROSTING TREATMENT.

NOTE

Do not apply anti-icing, deicing, and defrosting fluid to exposed aircraft surfaces if snow is expected. Melting snow will dilute the defrosting fluid and form a slush mixture that will freeze in place and become difficult to remove.

Use undiluted anti-icing, deicing, and defrosting fluid (MIL-A-8243) to treat aircraft surfaces for protection against freezing rain and frost. Spray aircraft surface sufficiently to wet area, but without excessive drainage. A fine spray is recommended to prevent waste.

Use diluted, hot fluid as follows to remove ice accumulations:

1. Remove frost or ice accumulations from aircraft surfaces by spraying with diluted anti-icing, deicing, and defrosting fluid mixed in accordance with Table 2-18.

2. Spray diluted, hot fluid in a solid stream (not over 15 gallons per minute). Thoroughly saturate aircraft surface and remove loose ice. Keep a sufficient quantity of diluted, hot fluid on aircraft surface coated with ice, to prevent liquid layer from freezing. Diluted, hot fluid should be sprayed at a high pressure, but not exceeding 300 psi.

3. When facilities for heating are not available and it is deemed necessary to remove ice accumulations from aircraft surfaces, undiluted defrosting fluid may be used. Spray undiluted defrosting fluid at 15-minute intervals to assure complete coverage. Removal of ice accumulations using undiluted defrosting fluid is expensive and slow.

If tires are frozen to ground, use undiluted defrosting fluid to melt ice around tire. Move aircraft as soon as tires are free.

2-97. APPLICATION OF EXTERNAL POWER.

CAUTION

Before connecting the power cables from the external power source to the aircraft, ensure that the GPU is not touching the aircraft at any point. Due to the voltage drop in the cables, the two ground systems will be of different potentials. Should they come in contact while the GPU is operating, arcing could occur. Turn off all external power while connecting the power cable to, or removing it from, the external power supply receptacle. Be certain that polarity of the external power source is the same as that of the aircraft before it is connected. GPU requirements are: 1000 amps capacity, 500 amps for 2 minutes, and 300-amperes, 28 Vdc continuous output.

An external power source is often needed to supply the electric current required to properly ground service the aircraft electrical equipment and to facilitate starting the aircraft's engines. An external dc power receptacle is installed on the underside of the right wing, just outboard of the engine nacelle.

2-98. SERVICING OXYGEN SYSTEM.

The oxygen system furnishes emergency breathing oxygen to the pilot, copilot, passengers, and first aid position. Oxygen cylinder location is shown in Figure 2-24.

a. Oxygen System Safety Precautions.

WARNING

Keep fire and heat away from oxygen equipment. Do not smoke while working with or near oxygen equipment, and take care not to generate sparks with carelessly handled tools when working on the oxygen system.

1. Keep oxygen regulators, cylinders, gauges, valves, fittings, masks, and all other components of the oxygen system free of oil, grease, gasoline, and all other readily combustible substances. The utmost care shall be exercised in servicing, handling, and inspecting the oxygen system.

2. Do not allow foreign matter to enter oxygen lines.

3. Never allow electrical equipment to come into contact with the oxygen cylinder.

4. Never use oxygen from a cylinder without first reducing its pressure through a regulator.

b. Replenishing Oxygen System.

1. Remove oxygen access door on outside of aircraft.

2. Remove protective cap on oxygen system filler valve.

3. Attach oxygen hose from oxygen servicing unit to filler valve.

WARNING

If the oxygen system pressure is below 200 psi, do not attempt to service system. Make an entry on DA Form 2408-13-1.

4. Ensure that supply cylinder shutoff valves on aircraft are open.

5. Slowly adjust valve position so that pressure increases at a rate not to exceed 200 psig per minute.

6. Close pressure regulating valve on oxygen servicing unit when pressure gauge on oxygen system indicates pressure obtained using the Oxygen System Servicing Pressure Chart, Figure 2-44.

NOTE

To compensate for loss of aircraft cylinder pressure as the oxygen cools to ambient temperature after recharging, the cylinder should be charged initially to approximately 10% over prescribed pressure. Experience will determine what initial pressure should be used to compensate for the subsequent pressure loss upon cooling. A complete recharge will create substantial heating.

7. Adjust the final stabilized cylinder pressure for ambient temperature per Figure 2-44.

8. Disconnect oxygen hose from oxygen servicing unit and filler valve.

9. Install protective cap on oxygen filler valve.

10. Install oxygen access door.

2-99. GROUND HANDLING.

Ground handling covers all the essential information concerning movement and handling of the aircraft while on the ground. The following paragraphs give, in detail, the instructions and precautions necessary to accomplish ground handling functions. Parking, covers, ground handling, and towing equipment are shown in Figure 2-45.

a. General Ground Handling Procedure. Accidents resulting in injury to personnel and damage to equipment can be avoided or minimized by close observance of existing safety standards and recognized ground handling procedures. Carelessness or insufficient knowledge of the aircraft or equipment being handled can be fatal. The applicable technical manuals and pertinent directives should be studied for familiarization with the aircraft, its components, and the ground handling procedures applicable to it, before attempting to accomplish ground handling.

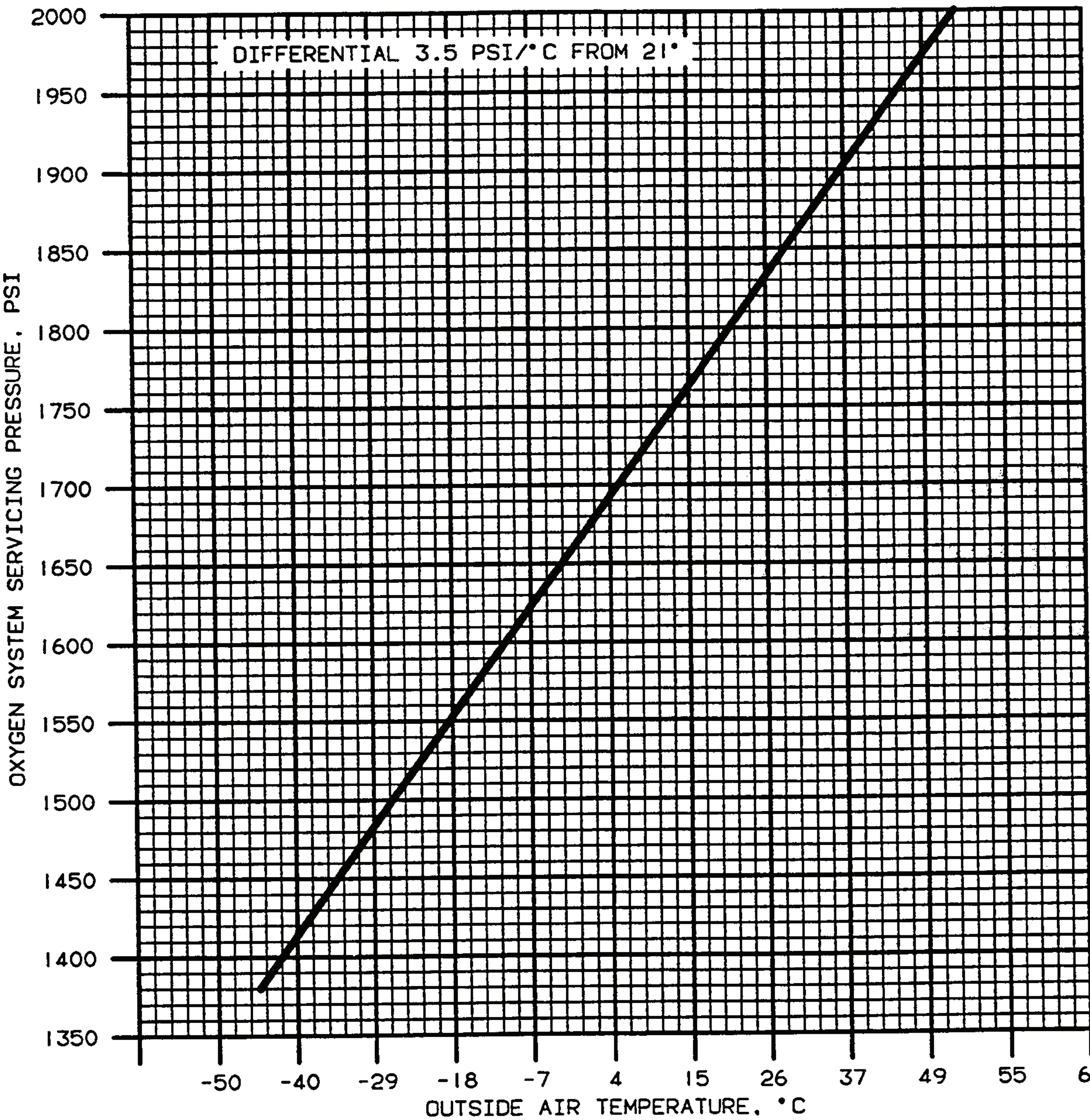


Figure 2-44. Oxygen System Servicing Pressure

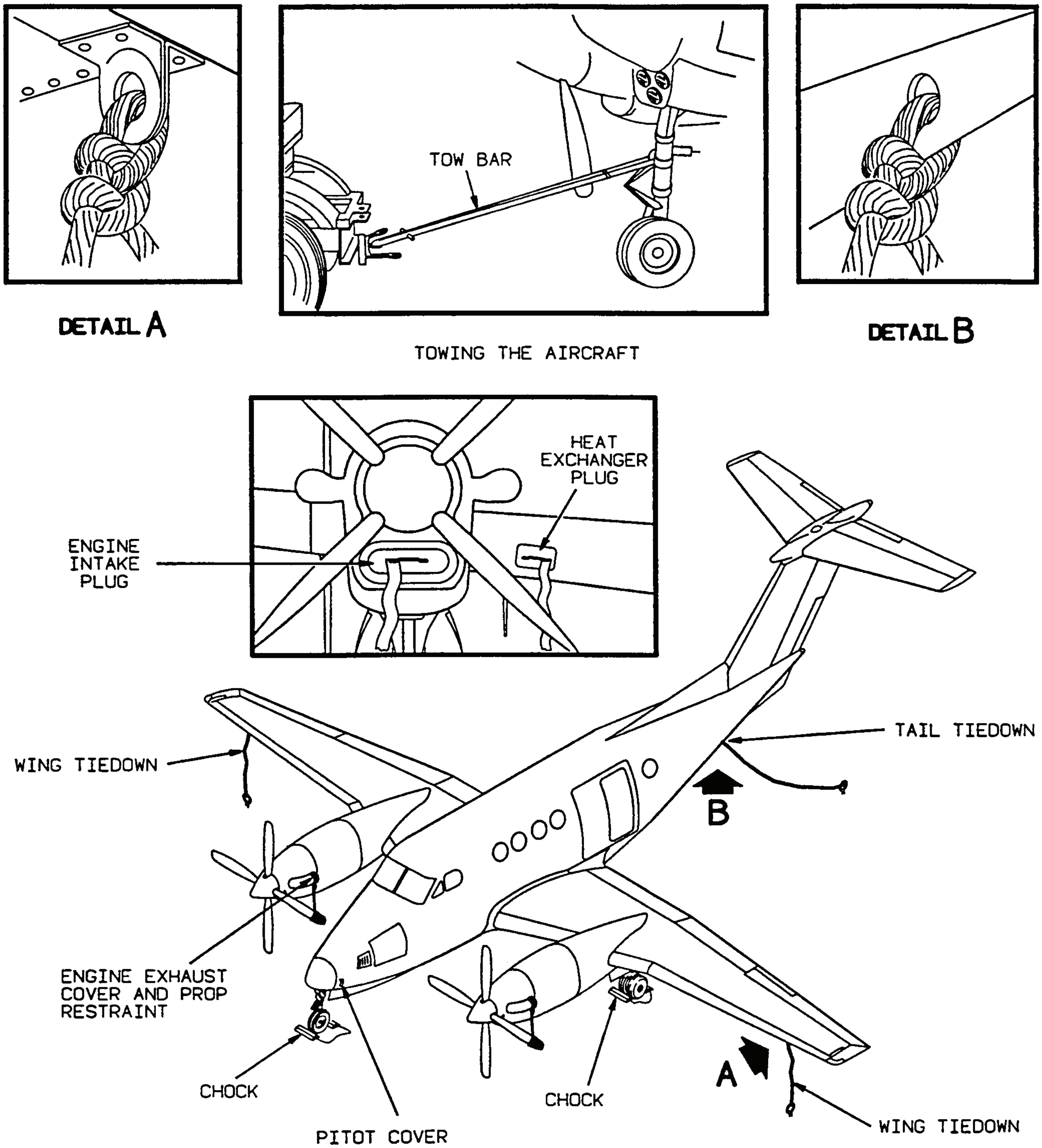


Figure 2-45. Parking, Covers, Ground Handling, and Towing Equipment

b. Ground Handling Safety Practices. Aircraft equipped with turboprop engines require additional maintenance safety practices. The following list of safety practices should be observed at all times to prevent possible injury to personnel and/or damaged or destroyed aircraft:

1. Keep intake air ducts free of loose articles such as rags, tools, etc.

2. Stay clear of exhaust outlet areas.

3. During ground run-up, ensure the brakes are firmly set.

4. Keep area fore and aft of propellers clear of maintenance equipment.

5. Do not operate engines with flight control surfaces in the locked position.

6. Do not attempt towing or taxiing of the aircraft with flight control surfaces in the locked position.

7. When high winds are present, do not unlock the control surfaces until prepared to properly operate them.

8. Do not operate engines while towing equipment is attached to the aircraft, or while the aircraft is tied down.

9. Check the nose wheel position. Unless it is in the centered position, avoid operating the engines at high power settings.

10. Hold control surfaces in the neutral position when the engines are being operated at high power settings.

11. When moving the aircraft, do not push on propeller deicing boots; damage to the heating elements may result.

c. Moving Aircraft on Ground. Aircraft on the ground shall be moved in accordance with the following:

(1) Taxiing. Taxiing shall be in accordance with Chapter 8.

CAUTION

When the aircraft is being towed, a qualified person should be in the pilot's seat to maintain control by use of the brakes. When towing, do not exceed nose gear turn limits, Figure 2-46. Avoid short radius turns, and always keep the inside or pivot wheel turning during the operation. Do not tow aircraft with rudder locks installed, as severe damage to the nose steering linkage can result. When moving the aircraft backwards, do not apply the brakes abruptly. Tow the aircraft slowly, avoiding sudden stops, especially over snowy, icy, rough, soggy, or muddy terrain. In Arctic climates, tow the aircraft by the main gears, as an immense breakaway load, resulting from ice, frozen tires, and stiffened grease in the wheel bearings may damage the nose gear.

Do not tow or taxi aircraft with deflated shock struts.

(2) Towing. Towing lugs are provided on the upper torque knee fitting of the nose strut. When it is necessary to tow the aircraft with a vehicle, use the vehicle tow bar. Never exceed the turn limit arrows displayed on the placard located on the nose gear assembly. Refer to Figure 2-46.

d. Ground Handling Under Extreme Weather Conditions. Extreme weather conditions necessitate particular care in ground handling of the aircraft. In hot, dry, sandy, desert conditions, special attention must be devoted to finding a firmly packed parking and towing area. If such areas are not available, steel mats or an equivalent solid base must be provided for these purposes. In wet, swampy areas, care must be taken to avoid bogging down the aircraft. Under cold, icy, Arctic conditions, additional mooring is required, and added precautions must be taken to avoid skidding during towing operations.

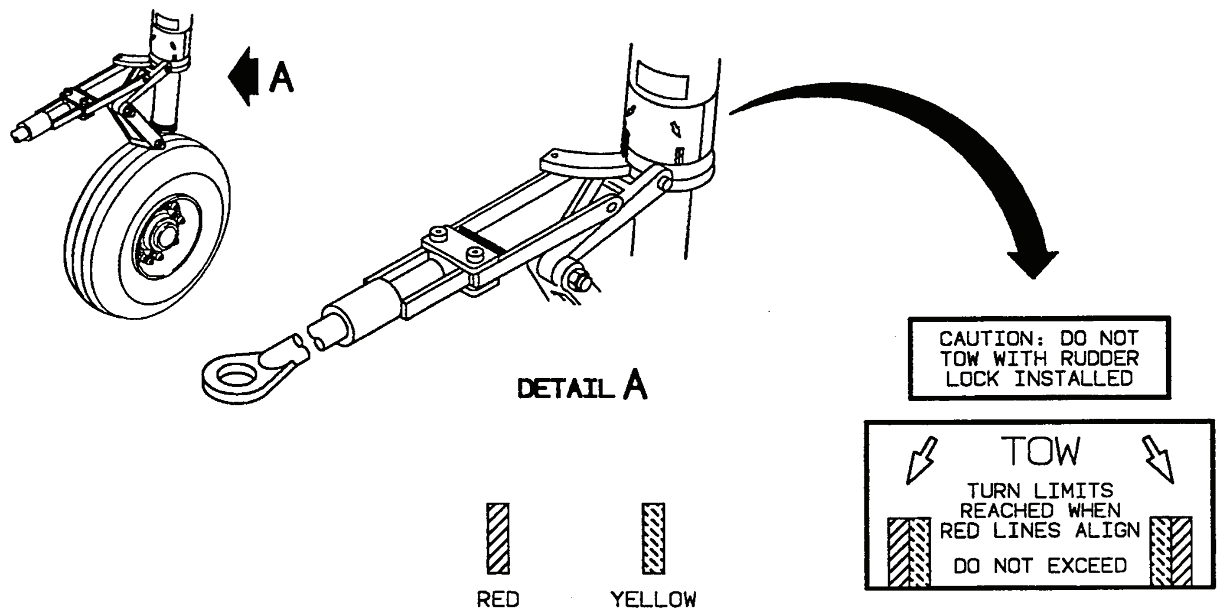


Figure 2-46. Towing Turn Limits

2-100. PARKING.

Parking is defined as the normal condition under which the aircraft will be secured while on the ground. This condition may vary from the temporary expedient of setting the parking brake and chocking the wheels to the more elaborate mooring procedures described under Mooring. The proper steps for securing the aircraft must be based on the time the aircraft will be left unattended, the aircraft weight, the expected wind direction and velocity, and the anticipated availability of ground and air crews for mooring and/or evacuation. When practical, head the aircraft into the wind, especially if strong winds are forecast or if it will be necessary to leave the aircraft overnight. Set the parking brake and chock the wheels securely. Following engine shutdown, position and engage the control locks.

NOTE

Cowlings and loose equipment will be suitably secured at all times when left in an unattended condition.

a. Parking Brake. The parking brake system for the aircraft incorporates two lever-type valves, one for each wheel brake. Both valves are closed simultaneously by pulling out the parking brake handle. Operate the parking brake as follows:

CAUTION

Do not set parking brakes when the brakes are hot during freezing ambient temperatures. Allow brakes to cool before setting parking brakes.

1. Press both brakes.

2. Pull parking brake handle out. This will cause the parking brake valves to lock the hydraulic fluid under pressure in the parking brake system, thereby retaining braking action.

3. Release brake pedals.

4. To release the parking brakes push in on the parking brake handle.

b. Control Lock. The control lock holds the engine and propeller control levers in a secure position. The elevator, rudder, and ailerons are secured in a neutral position. Install the control locks as follows:

1. With engine and propeller control levers in secure position, slide lock around the aligned control levers.

2. Install elevator and aileron lockpin through pilot's control column to lock control wheel.

3. Install rudder lock pin through floor mounted door, forward of pilot's seat, ensuring rudder is in neutral position.

4. Reverse steps 1 through 3 above to remove control lock. Store control lock.

2-101. INSTALLATION OF PROTECTIVE COVERS.

The crew will ensure that the aircraft protective covers are installed when leaving the aircraft.

2-102. MOORING.

The aircraft is moored to ensure its immovability, protection, and security under various weather conditions. The following paragraphs give, in detail, the instructions for proper mooring of the aircraft.

a. Mooring Provisions. Mooring points, Figure 2-47, are provided beneath the wings and tail. Additional mooring cables may be attached to each landing gear. General mooring equipment and procedures necessary to moor the aircraft, in addition to the following, are given in TM 1-1500-204-23.

1. Use mooring cables of 1⁄4 inch diameter aircraft cable and clamp (clip-wire rope), chain, or rope (3⁄4 inch diameter or larger). Length of the cable or rope will be dependent upon existing circumstances. Allow sufficient slack in ropes, chains, or cable to compensate for tightening action due to moisture absorption of rope or thermal contraction of cable or chain. Do not use slipknots. Use bowline knots to secure aircraft to mooring stakes.

2. Chock the wheels.

b. Mooring Procedures for High Winds. Structural damage can occur from high velocity winds; therefore, if at all possible, the aircraft should be moved to a safe weather area when winds above 75 knots are expected. Moored aircraft condition is shown in Figure 2-47. If aircraft must be secured, perform the following steps.

1. After aircraft is properly located, place nose wheel in centered position. Point aircraft into wind, or as nearly so as is possible within limits determined by locations of fixed mooring rings. When necessary, a 45-degree variation of direction is considered to be satisfactory. Locate each aircraft at slightly more than one wing span distance from all other aircraft. Position nose mooring point approximately 3 to 5 feet downwind from ground mooring anchors.

2. Deflate nose wheel shock strut to within 3⁄4 inch of its fully deflated position.

3. Fill all fuel tanks to capacity, if time permits.

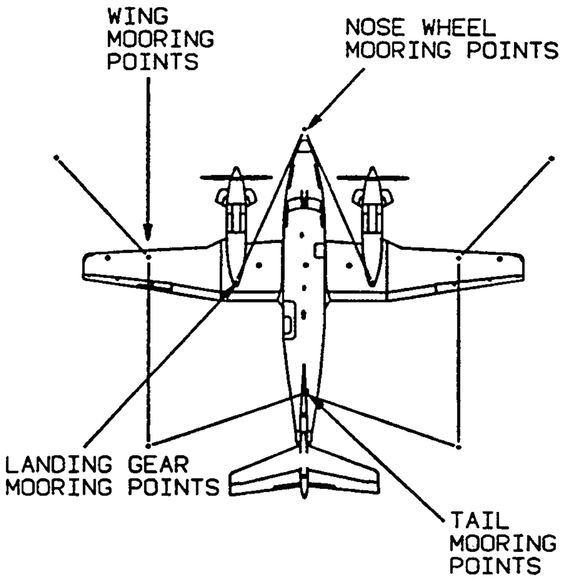
4. Place wheel chocks fore and aft of main gear wheels and nose wheel. Tie each pair of chocks together with rope or join together with wooden cleats nailed to chocks on either side of wheels. Tie ice grip chocks together with rope. Use sandbags in lieu of chocks when aircraft is moored on steel mats. Set parking brake as applicable.

5. Tie aircraft down by utilizing mooring points shown in Figure 2-47. Make tiedown with 1⁄4-inch aircraft cable using two wire rope clips, or bolts and a chain tested for a 3000-pound pull. Attach tiedowns so as to remove all slack. Use a 3⁄4-inch or larger manila rope if cable or chain tiedown is not available. If rope is used for tiedown, use anti-slip knots (such as bowline knot) rather than slip knots. In the event tiedown rings are not available on hard surfaced areas, move aircraft to an area where portable tiedowns can be used. Locate anchor rods at points shown in Figure 2-47. When anchor kits are not available, use metal stakes or dead-man type anchors, providing they can successfully sustain a minimum pull of 3000 pounds.

6. In event nose position tiedown is considered to be of doubtful security due to existing soil condition, drive additional anchor rods at nose tiedown position. Place padded work stand or other suitable support under the aft fuselage tiedown position and secure.

7. Place control surfaces in locked position and trim tab controls in neutral position. Place wing flaps in up position.

8. The requirements for dust excluders, protective covers, and taping of openings will be left to the discretion of the responsible maintenance officer or the pilot of the transient aircraft.



NOTE

IF STRONG WINDS ARE ANTICIPATED OR AIRCRAFT IS TO BE LEFT UNATTENDED, PROPELLER RESTRAINT, PITOT MAST, AND INTAKE COVERS MUST BE INSTALLED, AND THE FLIGHT CONTROLS LOCK ENGAGED.

THE USE OF DOUBLE OR SINGLE MOORING POINTS FOR NOSE AND/OR WING TIEDOWNS IS DETERMINED BY LOCAL OPTION DEPENDING ON TYPE AND AVAILABILITY OF AIRCRAFT SECURING EQUIPMENT.

USE ROPE ONLY (NYLON TYPE IS AVAILABLE) FOR NOSE TIEDOWN (DETAIL A). ATTACH ROPE(S) TO AIRCRAFT AND GROUND MOORING POINTS IN A MANNER THAT WILL PREVENT ROPE DAMAGE TO AIRCRAFT COMPONENTS.

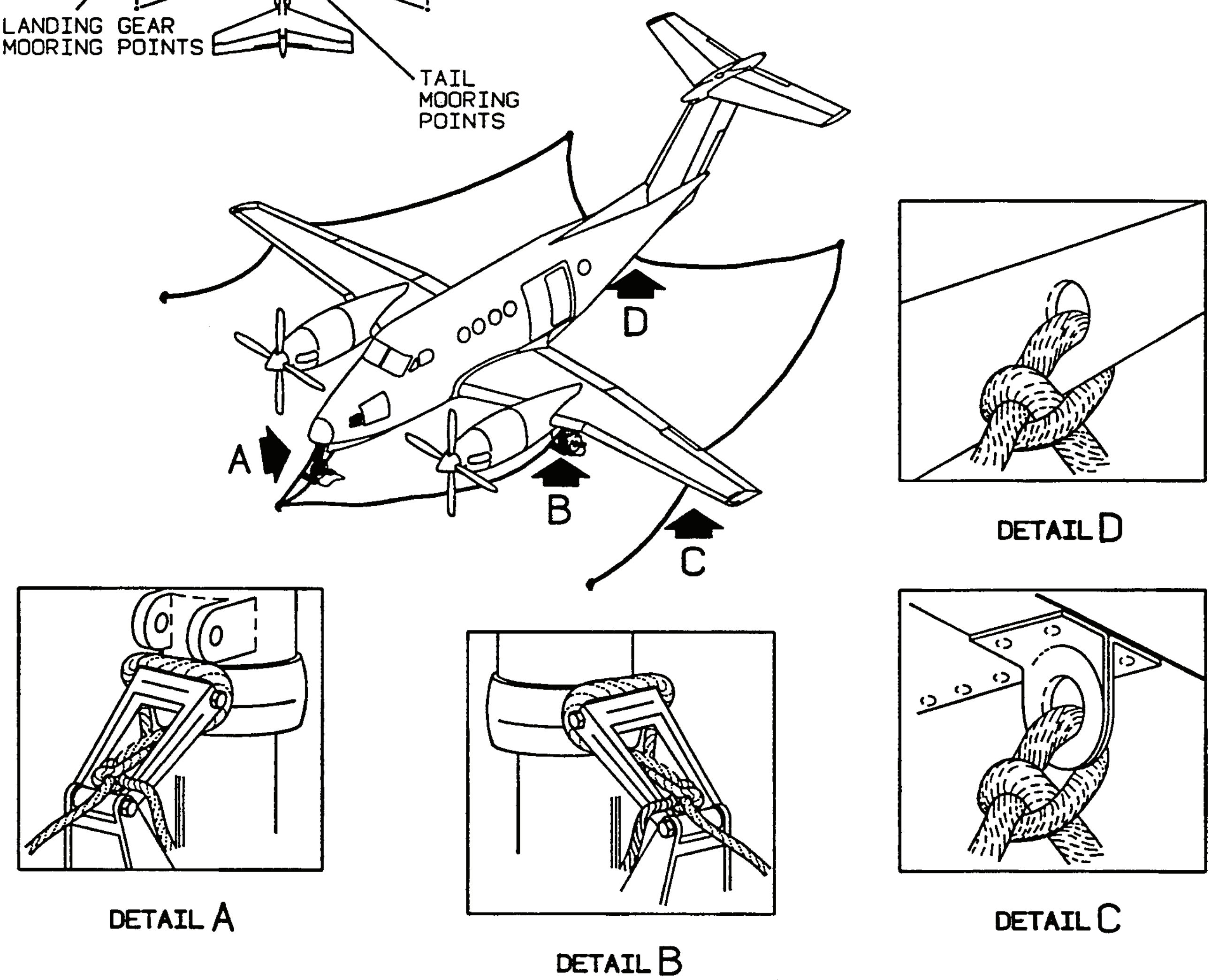


Figure 2-47. Mooring the Aircraft

9. Secure propellers to prevent windmilling.

10. Disconnect battery.

11. During typhoon or hurricane wind conditions, mooring security can be further increased by placing sandbags along the wings to break up the aerodynamic flow of air over the wing, thereby reducing the lift being applied against the mooring by the wind. The storm appears to pass two times, each time with a different wind direction. This will necessitate turning the aircraft after the first passing.

12. After high winds, inspect aircraft for visible signs of structural damage and for evidence of damage from flying objects. Service nose shock strut and reconnect battery.

CHAPTER 3
AVIONICS (COMMON) R T3 F3

Section I. GENERAL

3-1. INTRODUCTION.

This chapter covers all avionics equipment common to the C-12R, C-12T3, and C-12F3 aircraft. It provides a brief description of the equipment, the technical characteristics, and locations. It covers systems and controls, and provides the proper techniques and procedures to be employed when operating the equipment. For more detailed operational information consult the vendor manuals that accompany the aircraft loose tools.

3-2. AVIONICS EQUIPMENT CONFIGURATION.

The aircrafts' common avionics consist of two groups of electronic equipment. The communication group, which includes the HF communication set (KHF-950) and the VHF communications transceivers (VHF-22D), and the transponder and radar group, that includes the APX-100 transponder.

Section II. COMMUNICATIONS

3-3. HIGH FREQUENCY COMMUNICATION SET (KHF-950).

a. Description. The KHF-950 HF system consists of three units: the panel mounted KCU 951 control display, the remote KAC 952 power amplifier/antenna coupler, and the KTR 953 receiver/exciter. The system will operate on any 0.1 kHz frequency between 2,000 and 29,999.9 kHz.

With the capability to preset 99 frequencies for selection during flight, the system allows for either selection of other frequencies manually (direct tuning) or reprogramming of any preset frequency. The system will automatically match the antenna by keying the microphone.

The HF system has two methods of frequency selection. The first method is called direct tuning (frequency agile). The second is a channelized operation in which desired operating frequencies are preset, stored and referenced to a channel number.

b. HF Control Panel and Functions. The operating controls of the HF system are described in the following paragraphs and are illustrated in Figure 3-1.

(1) Frequency Display – Displays frequency selected.

(2) Mode Display – Displays LSB, AM, or USB indicating the mode.

(3) ***CHANNEL*** *Display* – Displays channel selected.

(4) Light Sensor – The built-in light sensor automatically controls the display brightness.

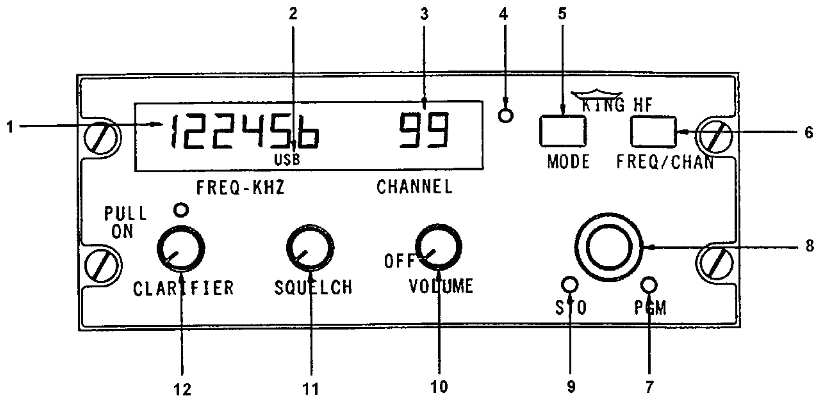
(5) Emission ***MODE*** *Switch* – The emission mode switch is a momentary push button that selects LSB, AM or USB.

(6) ***FREQ / CHAN*** *Switch* – Transfers the HF system from a direct frequency operation to a channelized form of operation.

(7) ***PGM*** *Button* – Enables channelized data to be modified. The **PGM** message will be displayed whenever this switch is pressed. The program mode must be used for setting or changing any of the 99 preset frequencies. Each of the 99 channels may be preset to receive and transmit on separate frequencies (semi-duplex), receive only, or transmit and receive on the same frequency (simplex). The operating mode, USB or AM, must be the same for both receive and transmit and can also be preset.

(8) Frequency/Channel Selector. This selector consists of two concentric knobs that control the channel and frequency digits, plus the lateral position of the cursor.

(a) Frequency Control. The outer knob becomes a cursor (flashing light) control with the **FREQ / CHAN** switch in the **FREQ** position. The flashing digit is then increased/decreased with the inner knob.



1. **Frequency Display**
2. **Mode Display**
3. **CHANNEL Display**
4. **Light Sensor**
5. **Emission MODE Switch**
6. **FREQ / CHAN Switch**
7. **PGM Button**
8. **Frequency / Channel Selector**
9. **STO Button**
10. **VOLUME / OFF Switch**
11. **SQUELCH Switch**
12. **CLARIFIER Switch**

Figure 3-1. HF Control Panel

(b) Channel Control. Outer knob that changes channel frequencies. The outer knob is not functional when the **FREQ / CHAN** switch is in the **CHAN** position. The inner knob will provide channel control from 1 through 99, displayed at the right end of the display window.

(9) ***STO*** *Button* – Stores displayed data when programming preset channels.

(10) ***VOLUME / OFF*** – Applies power to the unit and controls the audio output level.

(11) ***SQUELCH*** – Provides variable squelch threshold control.

(12) ***CLARIFIER*** – Provides 250 Hz of local oscillator adjustment.

c. Operation.

(1) Frequency Operation (Simplex Only). Each digit of the frequency may be selected instead of dialing up or down to a frequency. The larger concentric knob is used to select the digit to be changed. This digit will flash when selected. Rotation of the knob moves the flashing cursor the direction of rotation. After the digit to be changed is flashing, the smaller concentric knob is used to select the numeral desired. This process is repeated until the new frequency has been selected. The flashing cursor may then be stowed by moving it to the extreme left or right of the display and then one more click. This stows the cursor behind the display until needed again. The cursor may be recalled by turning the concentric knob one click left or right.

(a) Direct Frequency Tuning (Simplex Only).

1. **FREQ / CHAN** Button – Out (**FREQ**).
2. Select desired Mode – USB, LSB, or AM.
3. Select digit to be changed – Outer knob. Digit (Cursor) will flash.
4. Select numerical value of digit – Inner knob.
5. Stow cursor – Or repeat procedure for additional changes.
6. Tune antenna coupler – Press microphone button.

(2) Channel Programming. There are three ways to set up a channel: Receive only, simplex, and semi-duplex. To gain access to channelized operation, press **FREQ / CHAN** button. To utilize the existing programmed channels (i.e., no programming required), use the small control knob to select the desired channel number. Then momentarily key the

microphone to tune the antenna coupler. If channel programming is required, it is necessary to activate the program mode.

With the **FREQ / CHAN** button in **CHAN**, use a pencil or other pointed object to push the **PGM** button in. The letters **PGM** will appear in the lower part of the display window and the system will remain in the program mode until the **PGM** button is pressed again. Switch is alternate action: push-on, push-off.

(a) Receive Only.

1. Stow the cursor if a frequency digit is flashing.

2. Channel – Select.

3. Mode – Set (LSB, USB, or AM).

4. Frequency – Set as desired. Refer to frequency tuning.

5. Push and release **STO** button once.

TX will flash in the display window. A receive only frequency is being set, the flashing TX should be ignored.

If another channel is to be set, the cursor must be stowed before a new channel can be selected. Use the smaller concentric knob to select the channel and repeat the steps for selecting a new frequency.

6. To return to an operating mode, push the **PGM** button.

(b) Simplex. Setting a channel up for simplex operation (receive and transmit on the same frequency).

1. **FREQ / CHAN** Button – In (Cursor stowed).

2. **PGM** Button – In (**PGM** displayed).

3. Channel – Select.

4. Mode – Set (LSB, USB or AM).

5. Frequency – Set as desired. Refer to frequency tuning.

6. **STO** button – Push and release twice.

The first press of the **STO** button stores the frequency in the receive position and the second press stores the same frequency in the transmit position. The second push also stores the cursor.

If another channel is to be reset, use the smaller concentric knob to select the channel and repeat the steps for selecting a new frequency. The cursor was automatically stowed. To return to one of the operating modes, push the **PGM** button again.

(c) Semi-Duplex. Setting a channel for semi-duplex (transmit on one frequency and receive on another).

1. Channel – Select.

2. Frequency – Set as desired. Refer to frequency selection.

3. Mode – Set (USB, or AM).

4. **STO** button – Push once.

5. Set transmit frequency.

6. **STO** button – Push again.

NOTE

If another channel is to be reset, use the smaller concentric knob to select the channel and repeat the steps.

7. To return to an operating mode, push the **PGM** button.

NOTE

The mode for each channel (USB or AM) is stored along with the frequency. If the mode is changed, the system will receive and transmit in the mode selected for transmit.

3-4. VHF COMMUNICATIONS TRANSCEIVERS (VHF-22D).

a. Introduction. The VHF communications transceivers are an 8.33 kHz channel spacing cable system. The operation between the 25.00 kHz and 8.33 kHz modes is seamless. Within the space occupied by each 25.00 kHz frequency exist three 8.33 kHz channels. The 8.33 kHz "frequency" is referred to as a "channel," not the actual frequency tuned. The channel scheme avoids possible confusion associated with shared 25.00 kHz and 8.33 kHz frequencies. This method ensures that the equipment will always be operating in the proper spacing mode and occurs automatically as the user tunes the controller. The VHF-22D provides airborne VHF communications from 118.000 through 151.975 MHz and is operated by two CTL-22D transceiver control units.

The solid-state transceiver includes capture-effect automatic squelch to help prevent missed radio calls, plus audio leveling and response shaping to insure audio quality. Transmitter sidetone comes from detected transmitter signal, and is therefore a reliable check of transmission quality. Each VHF transceiver is powered through its respective circuit breaker, placarded **VHF # 1** or **VHF # 2**, located on the circuit breaker panel.

b. VHF Transceiver Operating Controls (VHF-22D). All operating controls for the transceivers are located on the CTL-22 transceiver control units. Refer to Figure 3-2.

(1) Active Frequency Display. Displays the active frequency (frequency to which the transceiver is tuned) and diagnostic messages.

(2) Transfer/Memory Switch. This switch is a three-position spring-loaded toggle switch placarded **XFR** / **MEM**, which, when held to the **XFR** position, causes the preset frequency to be transferred up to the active display and the transceiver to be returned. The previously active frequency will become the new preset frequency and will be displayed in the lower window. When this switch is held to the **MEM** position, one of the six stacked memory frequencies will be loaded into the preset display. Successive pushes will cycle the six memory frequencies through the display (...2, 3, 4, 5, 6, 1, 2, 3...).

(3) Store Button. This button, placarded **STO**, allows up to six preset frequencies to be selected and entered into the control unit's memory. After presetting the frequency to be stored, push the **STO** button. The upper window displays the channel number of available memory (CHAN 1 through CHAN 6) while the lower window continues to display the frequency to be stored. For approximately 5 seconds, the **MEM** switch may be used to advance through the channel numbers without changing the preset display. Push the **STO** button a second time to commit the preset frequency to memory in the selected location. After approximately 5 seconds, the control will return to normal operation.

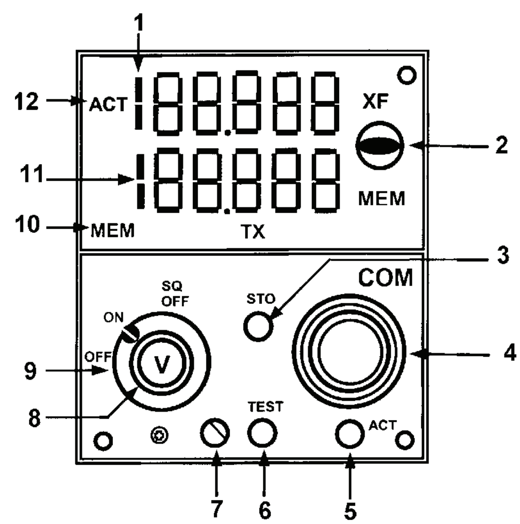
(4) Frequency Select Knobs. Two concentric tuning knobs control the preset or active frequency displays. The larger knob changes the three digits to the left of the decimal point in 1-MHz steps. The smaller knob changes the three digits to the right of the decimal point. The knob is "Rate Aided." The faster the kHz knob is turned, the more channels will be skipped. A single click of the kHz knob will either increase or decrease the channel by a single channel.

(5) Active Button. The active button, placarded **ACT**, enables the tuning knobs to directly tune the VHF transceiver, when pressed and held for 2 seconds. The bottom window will display dashes and the upper window will continue to display the active frequency. Pushing the **ACT** button a second time will return the control unit to the normal two-display mode.

(6) Test Button. This button, placarded **TEST**, initiates the transceiver self-test diagnostic routine. Self-test is active only when the **TEST** button is pressed.

(7) Light Sensor. This built-in light sensor automatically controls display brightness.

(8) Volume Control. The volume control is concentric with the power and mode switch.



1. **Active Frequency Display**
2. **Transfer/Memory Switch**
3. **Store Button**
4. **Frequency Select Knobs**
5. **Active Button**
6. **Test Button**
7. **Light Sensor**
8. **Volume Control**
9. **Power and Mode Switch**
10. **Annunciators (MEM TX)**
11. **Preset Frequency Display**
12. **Compare Annunciator**

Figure 3-2. VHF Communications Transceiver Control Unit

(9) Power and Mode Switch. The power and mode switch contains three detented positions. The **ON** and **OFF** positions switch system power. The **SQ OFF** position disables the receiver squelch circuits.

(10) Annunciators. The transceiver control unit contains a **MEM** (memory) and a **TX** (transmit) annunciator. The **MEM** annunciator illuminates whenever a preset frequency is being displayed in the lower window. The **TX** annunciator illuminates whenever the transceiver is transmitting.

(11) Preset Frequency Display. Displays the pre-set (inactive) frequency and diagnostic messages in the lower window.

(12) Compare Annunciator. An annunciator, placarded **ACT**, momentarily illuminates when frequencies are being changed. The **ACT** annunciator flashes if the actual radio frequency to which the transceiver is tuned is not identical to the frequency shown in the active frequency display.

WARNING

If two communications transceivers in the same aircraft are tuned to stations carrying the same voice message, attempting to listen to the received signals from both simultaneously could result in a great reduction in the actual audio volume.

c. Operating Procedures. The 8.33 kHz capable CTL-22D shows the VHF COM frequency as a channel frequency using all six digits of the display. There are no 8.33 kHz channels above 136.992 MHz. The last “channel name” is 136.990, which is an actual frequency of 136.9917 MHz. Table 3-1 shows the channel/frequency scheme for the 180.000 to 136.992-MHz range. While the CTL is in the frequency range of 137.000 to 151.975 MHz, the unit behaves the same as a 25.00 kHz only unit.

NOTE

It is possible that erroneous operation could occur without a fault indication. It is the responsibility of the pilot to detect such an occurrence by continually assessing the reasonableness of operation as displayed on the associated transceiver control unit and by the quality of received signals and transmissions.

Table 3-1. VHF Communications Transceiver Control UnitChannel/Frequency Scheme (118.000 To 136.992 MHz Range)

FREQUENCY	SPACING (kHz)	CHANNEL NAME (DISPLAYED)	FREQUENCY	SPACING (kHz)	CHANNEL NAME (DISPLAYED)
118.0000	25.00	118.000	118.0750	25.00	118.075
118.0000	8.33	118.005	118.0750	8.33	118.080
118.0083	8.33	118.010	118.0833	8.33	118.085
118.0167	8.33	118.015	118.0917	8.33	118.090
118.0250	25.00	118.025	118.1000	25.00	118.100
118.0250	8.33	118.030	•	•	•
118.0333	8.33	118.035	•	•	•
118.0417	8.33	118.040	•	•	•
118.0500	25.00	118.050	136.9750	25.00	136.975
118.0500	8.33	118.055	136.9750	8.33	136.980
118.0583	8.33	118.060	136.9833	8.33	136.985
118.0667	8.33	118.065	136.9917	8.33	136.990

(1) Equipment Startup. The transceiver and the control unit are turned on by rotating the power and mode switch on the transceiver control unit to the **ON** position. When the transceiver is first turned on, it sounds a brief tone while the microprocessor checks its own memory. If there is a memory defect the tone continues, indicating that the transceiver can neither receive nor transmit. After the memory check, the transceiver control unit will display the same active and preset frequencies that were present when the equipment was last turned off.

NOTE

If two short 800-Hz tones are heard, the transceiver has detected an internal fault. Push the TEST button on the transceiver control unit to initiate self-test and display the fault code.

Adjust the volume and perform a quick squelch test by setting the power and mode switch on the transceiver control unit to **SQ OFF** and adjusting the volume level with background noise. After a comfortable listening level has been established, return the power and mode switch to the **ON** position. AU background noise should disappear unless a station or aircraft is transmitting on the active frequency.

(2) Frequency Selection. Frequency selection is made using either the frequency select knobs, or the transfer/memory (**XFR** / **MEM**) recall switch.

NOTE

There is usually an installer supplied 8.33/25.00 kHz select switch in the cockpit. This switch provides a convenience to the pilots by not having to "ratchet pass" the 8.33 kHz channels when not operating in 8.33 airspace. The selected position (8.33 or 25.00) select switch may or may not be annunciated, depending on installation.

After the desired frequency is set into the preset frequency display, it can be transferred to the active frequency display by momentarily setting the **XFR** / **MEM** switch to **XFR**. At the same time that the preset frequency is transferred to the active display, the previously active frequency is transferred to the preset display. A short audio tone is applied to the audio system to indicate that the active frequency has been changed, and the active (**ACT**) annunciator on the control will flash while the transceiver is tuning to the new frequency.

NOTE

The active annunciator continuing to flash indicates that the transceiver is not tuned to the frequency displayed in the active display.

The transceiver control unit's memory permits storing up to six preset frequencies. Once stored, these frequencies can be recalled to the preset display by positioning the **XFR** / **MEM** switch to the **MEM** position. The storage location (CHAN 1 through CHAN 6) for the recalled frequency is displayed in the active frequency display while the **XFR** / **MEM** switch is held in the **MEM** position. All six stored frequencies can be displayed one at a time in the preset display by repeatedly positioning the **XFR** / **MEM** switch to the **MEM** position. After the desired stored frequency has been recalled to the preset display, it can be transferred to the active display by momentarily positioning the **XFR** / **MEM** switch to the **XFR** position.

During normal operation, all frequency selections and revisions are done in the preset frequency display. However, the active frequency can be selected directly as described in the following paragraph.

(3) Direct Active Frequency Selection. The active frequency can be selected directly with the frequency select knobs by pushing the **ACT** button for about 2 seconds. The active frequency selection mode is indicated by dashes appearing in the preset display. Also, the **ACT** annunciator will flash as the frequency select knobs are turned to indicate that the transceiver is being returned.

NOTE

The ACT annunciator continuing to flash after the frequency has been selected indicates that the transceiver is not tuned to the frequency displayed in the active display.

To return to the preset frequency selection mode, push the **ACT** button again for about 2 seconds. As a safety feature, the transceiver control unit switches to the active frequency selection mode when a frequency select knob is operated while the **STO** and **TEST** buttons, or **XFR** / **MEM** switch are actuated.

(4) Frequency Storage. To program the memory, select the frequency in the preset frequency display using the frequency select knobs and push the **STO** button once. One of the channel numbers (CHAN 1 through CHAN 6) will appear in the active display for approximately 5 seconds. During this time the channel number can be changed without changing the preset frequency by momentarily positioning the

XFR / **MEM** switch to the **MEM** position. After the desired channel number has been selected, push the **STO** button again to store the frequency.

NOTE

When storing a frequency, the second actuation of the STO button must be done within 5 seconds after selecting the channel number or the first actuation of the STO button. If more than 5 seconds elapse, the control will revert to the normal modes of operation and the second store command will be interpreted as the first store command.

After a frequency has been stored in memory, it will remain there until changed by using the **STO** button. Memory is retained even when the unit is turned off for an extended period of time.

(5) Stuck Microphone Switch. Each time the push-to-talk switch is pressed, the microprocessor in the transceiver starts a 2-minute timer. The TX annunciator on the transceiver control unit will be illuminated whenever the transmitter is transmitting. If the transmitter is still transmitting at the end of 2 minutes, the microprocessor turns it off. Most intentional transmissions last much less than 1 minute; a 2-minute transmission is most likely the result of a stuck microphone switch. This timing feature protects the ATC channel from long-term interference.

When it turns off the transmitter, the microprocessor switches the transceiver to receive operation. A stuck microphone switch will prevent you from hearing received signals, or the two warning beeps. The microprocessor then waits until the push-to-talk switch opens to sound the two beeps.

To transmit for more than 2 minutes, release the microphone switch briefly and then press it again. The 2-minute timer resets and starts a new count each time the microphone switch is pressed.

(6) Overtemperature Protection. The microprocessor regularly monitors the temperature of the transmitter. If the transmitter gets too hot during a transmission, the microprocessor will stop the transmission, and the sidetone will cease. When the microphone switch is released, you will hear two beeps. Press the **TEST** switch on the transceiver control unit to observe the fault code. As long as the temperature remains above the limit, the microprocessor will not respond to a normal push of the microphone switch. If you must transmit, however, you can override the protection by rapidly keying the microphone switch twice, holding it on the second push. The shutdown temperature is 160 °C (320 °F).

(7) Self-test. An extensive self-test diagnostic routine can be initiated in the transceiver by pushing the **TEST** button on the transceiver control unit. The control unit will modulate the active and preset display intensity from minimum to maximum to annunciate that self-test is in progress. Several audio tones will be heard from the audio system while the self-test routine is being executed. At the completion of the self-test program, the transceiver control unit will usually display dashes in the active display, and 00 in the preset display. This indicates normal operation. If any out-of-limit condition is found, transceiver control unit will display DIAG (diagnostic) in the active display and a 2-digit fault code in the preset display. Record any fault codes displayed to help the service technician locate the problem. Refer to Table 3-2 for a description of the self-test fault codes that can be displayed on the transceiver control unit. The **TEST** button must be pushed before any fault code can be displayed.

Table 3-2. Self-test Codes

FAULT/CODE DESCRIPTION			
00	No fault found	15	Frequency out of range
01	5 Vdc below limit	16	Forward power below limit
02	5 Vdc above limit	17	Transmitter temperature excessive
03	12 Vdc below limit	21	Tuning voltage out of limit at highest receive frequency
04	12 Vdc above limit	22	Tuning voltage out of limit at 118 MHz
05	Synthesizer not locked	23	Local oscillator output below limit
07	Noise squelch open without signal	24	No-signal AGC voltage too high
08	Noise squelch open without signal	25	Inadequate AGC voltage increase with rf signal
12	BCD frequency code invalid	26	Reflected rf power above limit
13	2/5 frequency code invalid	27	Transmitter timed out
14	Serial message invalid		

Section III. NAVIGATION

Not Applicable

Section IV. TRANSPONDER

3-5. TRANSPONDER – APX-100.

a. Description. The transponder (APX-100) system is a position tracking, identification, altitude reporting, and emergency-tracking device. This set receives, decodes, and responds to interrogations by search radar. Range of the set is normally limited to line-of-sight.

b. Operating Controls and Functions. The operating controls of the transponder system are described as follows and illustrated in Figure 3-3.

(1) ***TEST GO*** *Indicator* – Illumination indicates successful completion of built-in-test (BIT).

(2) ***TEST / MON*** *Indicator* – Illumination indicates unit has malfunctioned, or interrogation by a ground station (**MON**).

(3) ***ANT*** *Switch*.

WARNING

Place the TOP / BOT / DIV switch in the DIV position during flight operations. Do not use the TOP or BOT position. This does not preclude using the TOP or BOT switch position for ground based system checks.

(a) ***TOP*** – Selects use of top antenna.

(b) ***DIV*** – Selects diversity operation using both antennas.

(c) ***BOT*** – Selects use of bottom antenna.

(4) ***RAD TEST OUT*** *Switch*. Enables an appropriately equipped transponder to reply test mode interrogations from an AN/UPM-92 or similar test set.

(5) ***MASTER*** *Control.*

(a) ***OFF*** – Turns set **OFF**.

(b) ***STBY*** – Places set in warmup (standby) condition. Red NO-GO light is **ON** in standby position.

(c) ***NORM***. Operates set at normal sensitivity.

(d) ***EMER***. Transmits emergency reply code.

(6) ***STATUS ANT*** *Indicator* – Illumination indicates the BIT or **MON** failure is due to high VSWR in antenna.

(7) ***STATUS KIT*** *Indicator* – Illumination indicates the BIT or **MON** failure is due to external computer.

(8) ***STATUS ALT*** *Indicator* – Illumination indicates the BIT or **MON** failure is due to Altitude Digitizer.

(9) ***IDENT MIC*** *Switch*.

(a) ***IDENT*** – Activates transmission of identification (IP) pulse.

(b) ***MIC*** – Enables the **POS IDENT** button located only on the pilot's side **CONTROL** wheel to activate transmission of **IDENT** signal from transponder.

(c) ***OUT*** – Disables **IDENT MIC**.

(10) ***MODE 4 REPLY*** *Indicator* – Illumination indicates that a **REPLY** has been made to a valid **MODE 4** interrogation or will flash when in standby position and interrogated for **MODE 4**.

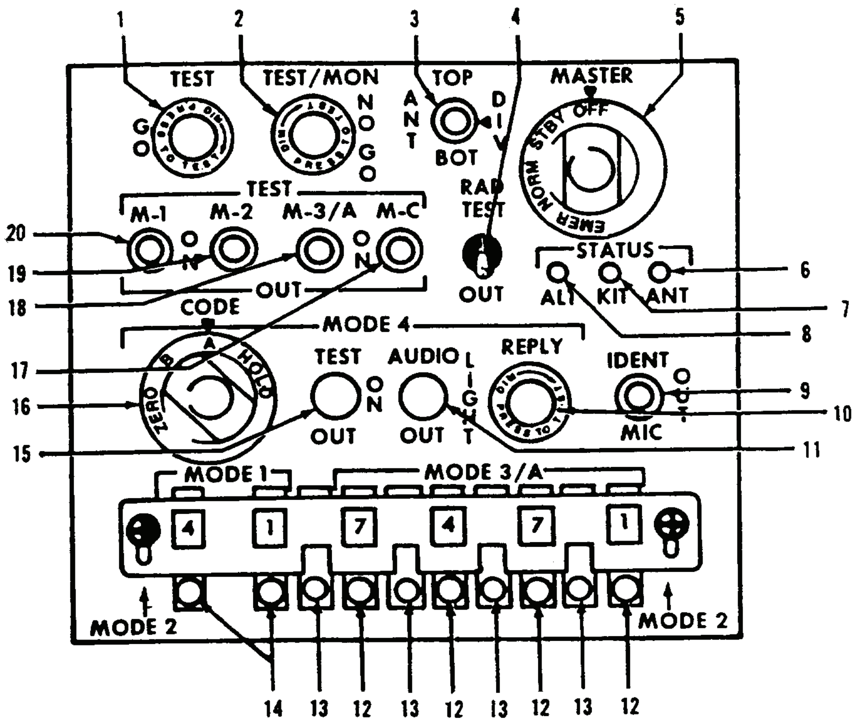
(11) ***MODE 4 AUDIO / LIGHT / OUT*** *Switch*.

WARNING

If the MODE 4 computer is installed in the aircraft, place the AUDIO / LIGHT / OUT switch in the AUDIO or LIGHT position during flight operations. Do not use the OUT position.

(a) ***AUDIO*** – Permits aural and **REPLY** light monitoring of valid **MODE 4** interrogations and replies.

(b) ***LIGHT*** – Permits **REPLY** indicator only monitoring.



1. TEST-GO Indicator
2. TEST / MON-NO GO Indicator
3. ANT Switch
4. RAD / TEST / OUT Switch
5. MASTER Control
6. STATUS ANT Indicator
7. STATUS KIT Indicator
8. STATUS ALT Indicator
9. IDENT-MIC Switch
10. MODE 4 REPLY Indicator
11. MODE 4 AUDIO / LIGHT / OUT Switch
12. MODE 3/A Code Selectors
13. MODE 2 Code Selectors
14. MODE 1 Code Selectors
15. MODE 4 TEST / ON / OUT Switch
16. MODE 4 Code Control
17. M-C TEST Switch
18. M-3/A TEST Switch
19. M-2 TEST Switch
20. M-1 TEST Switch

Figure 3-3. APX-100 Transponder Control Panel

(c) ***OUT*** – Disables monitoring capability.

(12) ***MODE 3/A CODE*** *Selectors* – Selects the desired reply codes for **MODE 3/A**.

NOTE

The cover over the MODE select switches must be slid forward to display the selected MODE 2 CODE.

(13) ***MODE 2 CODE*** *Selectors* – Selects the desired reply codes for **MODE 2**.

(14) ***MODE 1 CODE*** *Selectors* – Selects the desired reply code for **MODE 1**.

(15) ***MODE 4 TEST / ON / OUT*** *Switch*.

(a) ***TEST*** – Initiates BIT of **MODE 4** operation.

(b) ***ON*** – Enables **MODE 4** operation.

(c) ***OUT*** – Disables **MODE 4** operation.

(16) ***MODE 4 CODE*** *Control*. Selects dialed in **MODE 4 CODE** of the day.

(17) ***M-C TEST*** *Switch*.

(a) ***TEST*** – Permits self-test in the selected mode.

(b) ***ON*** – Permits set to reply in the selected mode.

(c) ***OUT*** – Disables replies.

*(18) **M-3/A TEST** Switch*.

(a) ***TEST*** – Permits self-test in the selected mode.

(b) ***ON*** – Permits set to reply in the selected mode.

(c) ***OUT*** – Disables replies.

*(19) **M-2** Test Switch*.

(a) ***TEST*** – Permits self-test in the selected mode.

(b) ***ON*** **–** Permits set to reply in the selected mode.

(c) ***OUT*** – Disables replies.

*(20) **M-1 TEST** Switch*.

(a) ***TEST*** – Permits self-test in the selected mode.

(b) ***ON*** – Permits set to reply in the selected mode.

(c) ***OUT*** – Disables replies.

(21) Control Wheel ***R*** ***F3*** . An **IDENT** push button is located on the pilot's control wheel. When pressed, the transponder transmits identification reply to ground. Refer to Figure 2-22.

c. Transponder Operations.

(1) Activation/Test Procedure. Perform the following setup/test procedures each time the APX-100 transponder is activated.

NOTE

Do not perform any checks with the master switch in EMERG or with M-3/A codes 7500, 7600 or 7700 without first obtaining authorization from the interrogating station(s).

1. Ensure the **MASTER** switch is in the **STBY** position.

2. Allow transponder to warm up for 2 minutes before operation.

3. Operate the press-to-test feature to the **TEST** indicator light to ensure light illuminates.

4. Test each **MODE** (**M-1**, **M-2**, **M-3/A**, and **M-C**) individually by momentarily holding each **MODE** switch in the **TEST** position. The green test indicator light should illuminate each time.

5. Return all switches to the normal operating position.

(2) Operating Procedures. The Activation/ Test Procedures above will leave the APX-100 in an operating condition. The following additional steps may be required, depending upon mission instructions.

NOTE

If the external security computer is not installed in the aircraft, a NO-GO light will illuminate any time the MODE 4 switch is moved out of the OFF position.

1. Change the **MODE 4 CODE** rotary switch from **A** to **B**.

2. If it is desired to retain the **CODE** in the external computer during a temporary shutdown for passenger discharge or refueling, rotate the **MODE 4 CODE** switch to **HOLD** prior to touchdown and then release it. Wait 15 seconds before turning the **MASTER** rotary switch to **OFF**.

3. Dumping the **CODE** in the external computer is accomplished by turning the **MODE 4 CODE** switch to **ZERO**.

4. Set any of the **M-1**, **M-2**, **M-3/A**, **M-C**, or **MODE 4** switches to **OUT** to inhibit transmission of replies in the undesired modes.

5. Set the **IDENT** / **OUT** / **MIC** switch momentarily to **IDENT** in order to transmit the identification of position (I/P) pulses. Placing this switch in the **MIC** position will allow transmission of I/P pulses when either **CONTROL** wheel **POS IDENT** button is pressed, I/P transmission pulses last for 15 to 30 seconds.

(3) Shutdown Procedures. Rotate the **MASTER** switch to **OFF**. This will automatically zero the external computer codes unless they have been retained as in step 2 of Operating Procedure.

CHAPTER 3A
AVIONICS R

Section I. GENERAL

3A-1. INTRODUCTION.

This chapter covers all avionics equipment installed in the C-12 R aircraft. It provides a brief description of the equipment, the technical characteristics, and locations. It covers systems and controls and provides the proper techniques and procedures for operating the equipment. For more detailed operational information, consult the vendor manuals that accompany the aircraft loose tools.

3A-2. AVIONICS EQUIPMENT CONFIGURATION.

The aircraft's avionics consist of three groups of electronic equipment. The communication group consists of the intercom system, AM/FM (VHF/UHF) transceiver, two VHF-AM transceivers, HF transceiver, an Emergency Locator Transmitter (ELT), and a cockpit voice recorder. The navigation group consists of two VOR/localizer/glideslope/marker beacon receivers, Automatic Direction Finder (ADF) receiver, TACAN receiver, a multi-sensor navigation system, a radio altimeter system, a gyromagnetic compass system, an Electronic Flight Instrument System (EFIS), and a digital integrated flight control system. The transponder and radar group consists of a weather radar system, transponder, and a servoed encoding altimeter indicator. The transponder and radar group includes an identification, position, and emergency tracking system, and a radar system to locate potentially dangerous weather areas. A Ground Proximity Altitude Advisory System (GPAAS) is also installed.

3A-3. POWER SOURCE.

a. DC Power. DC power for the avionics equipment is provided from four sources: the aircraft battery, left and right generators, and external power. Power is routed through two 50-ampere circuit breakers to the avionics power relay, which is controlled by the **AVIONICS MASTER PWR** switch located on the pilot's subpanel, Figure 2-5. Individual system circuit breakers are shown in Figure 2-6 and the associated avionics buses are shown in Figure 2-27, Sheet 1 and Table 2-7.

b. AVIONICS MASTER PWR Switch. A switch, placarded **AVIONICS MASTER PWR OFF**, located on the pilot's subpanel, controls power to the avionics buses.

(1) ***OFF***. In the **OFF** position, power from the 5-amp circuit breaker, placarded **AVIONICS MASTER**, located on the right sidewall circuit breaker panel, Figure 2-6, energizes the avionics relay, removing power from the avionics buses.

(2) On. With the switch in the on position, the avionics power relay is de-energized and power is applied to the avionics buses.

NOTE

If the AVIONICS MASTER PWR switch fails to operate, provide power to the individual avionics circuit breakers by pulling the 5-ampere circuit breaker, placarded AVIONICS MASTER, located on the right sidewall circuit breaker panel.

c. Single-Phase AC Power. Two static inverters supply 400 Hz single-phase 115 volt and 26 Vac electrical power to the avionics equipment. The inverters are controlled by a switch, placarded **INVERTER, NO 1 / OFF / NO 2**, located on the pilot's subpanel.

Section II. COMMUNICATIONS

3A-4. COMMUNICATIONS EQUIPMENT GROUP DESCRIPTION.

The communications equipment group consists of an intercom system connected to a dual audio control panel serving both the pilot and copilot, which interfaces with VHF, UHF, and HF transceivers and provides reception of audio from VOR, localizer, marker beacon, TACAN/DME, and ADF receivers.

3A-5. MICROPHONES, SWITCHES, AND JACKS.

Boom and oxygen mask microphones can be used in the aircraft.

a. Control Wheel Microphone Switches. The pilot and copilot are each provided with control wheel microphone switches, placarded **MIC**, located behind the outboard handgrip of their respective control wheels. Refer to Figure 2-22. When the control wheel microphone switches are pressed, voice audio signals from the respective microphone are routed to the transmitter selected by the respective transmitter selector switch, located on the audio control panel.

b. Cockpit Floor Foot-Operated Microphone Switch. The copilot is provided with a foot-operated microphone switch, placarded **MIC**, located on the cockpit floor, forward of his respective seat position. Pressing the foot-operated microphone switch routes audio signals to the device selected by the copilot's transmitter selector switch located on the audio control panel.

c. Microphone Jack Selector Switches. Two switches, placarded **MIC**, **MIC**, **NORMAL – OXYGEN MASK**, located on the left and right sides of the instrument panel, provide a means of selecting which microphone jack is connected to the audio system. When the pilot's or copilot's switch is set to the **NORMAL** position, the headset jack is connected to the respective audio system. When set to the **OXYGEN MASK** position, the oxygen mask jack is connected to the respective audio system.

3A-6. AUDIO CONTROL PANELS.

a. Description. A dual audio control panel located on the instrument panel serves both the pilot and copilot. Its respective 2-amp circuit breaker, placarded **PILOT AUDIO** and **COPILOT AUDIO**, located on the right sidewall circuit breaker panel powers each audio control panel, Figure 2-6.

b. Audio Control Panel Controls and Functions. Refer to Figure 3A-1.

(1) Pilot's and Copilot's Receiver Audio Monitor Switches. The pilot and copilot are each provided with a set of identical receiver audio monitor switches, placarded **PILOT** and **COPILOT AUDIO OFF**.

(a) ***VHF 1*** *and* ***VHF 2***. These switches connect the user's headset or speaker to the number 1 or 2 VHF communications transceiver audio.

(b) ***AM / FM***. These switches connect the user's headset or speaker to the AM/FM (VHF/UHF) communications transceiver audio.

(c) ***HF***. These switches connect the user's headset or speaker to the HF communications transceiver audio.

(d) ***NAV 1*** *and* ***2***. These switches connect the user's headset or speaker to the number 1 or 2 VHF navigation receiver audio.

(e) ***MKR BCN***. These switches connect the user's headset or speaker to the marker beacon receiver audio.

(f) ***DME 1*** *and* ***2***. These switches connect the user's headset or speaker to the number 1 or 2 DME transceiver audio.

(g) ***ADF***. These switches connect the user's headset or speaker to the **ADF** navigation receiver audio.

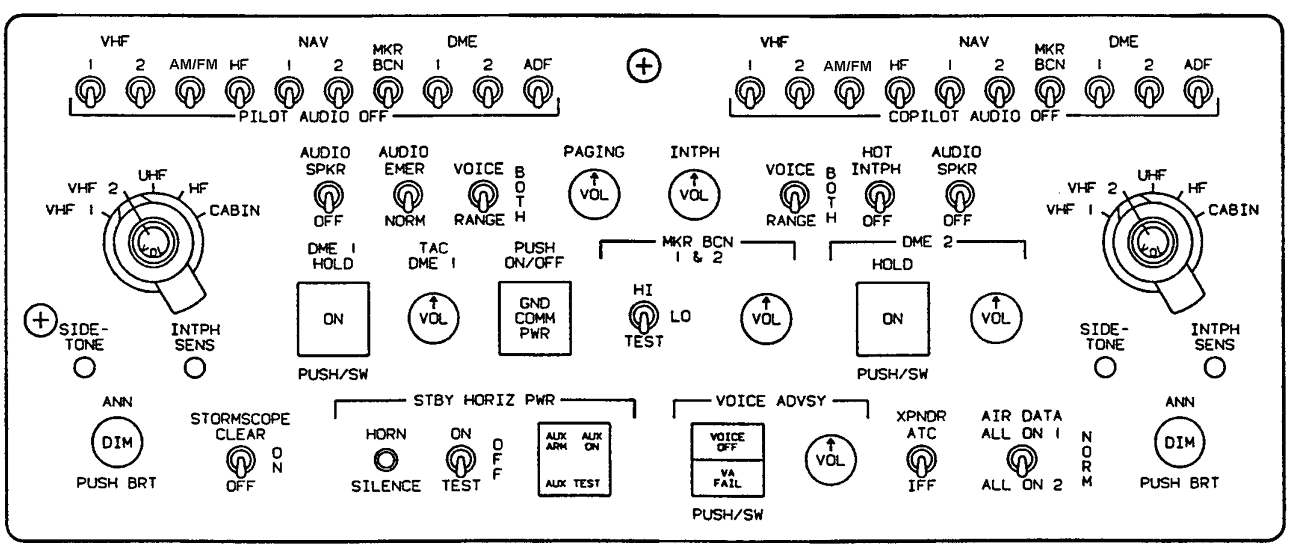


Figure 3A-1. Audio Control Panel

(2) Transmitter Selector Switches.

(a) ***VHF 1*** *and* ***VHF 2*** *Position*. These positions connect the user's headset or speaker to audio from, and connect user's microphone to the respective VHF communications transceiver transmitter.

(b) ***AM / FM*** *Position*. These positions connect the user's headset or speaker to audio from and connect user's microphone to the AM/FM (VHF/UHF) communications transceiver transmitter.

(c) ***HF***. This position connects the user's headset or speaker to audio from, and connects user's microphone to the respective HF communications transceiver transmitter.

(d) ***CABIN*** *Position*. This position connects user's microphone to the cabin speakers.

(3) Master Volume Control. The master volume control, placarded **VOL**, located on the transmitter selector switches, controls audio volume.

(4) Cockpit Speaker Switch. This switch, placarded **AUDIO SPKR OFF**, is set to the on up position to route desired audio to the cockpit speakers.

(5) Audio Emergency/Normal Switch. A two-position switch placarded **AUDIO EMER / NORM**, provides a means of selecting a secondary audio source in the event of a failure disabling both audio amplifiers. When the switch is set to the **EMER** position, power is removed from both audio amplifiers and audio is routed directly from the receivers to the headsets. Speaker audio and cabin intercom will be inoperative. When the switch is set to the **NORM** position, audio is routed normally through an amplifier to speakers or headsets.

(6) Voice/Range Switch. The pilot and copilot are each provided with a three-position switch, placarded **VOICE / BOTH / RANGE**, which controls selection of ADF voice or range filtering. When the switch is set to the **VOICE** position, the range tone is disabled, enhancing voice identification. When the switch is set to the **RANGE** position, the 1020 Hz range tone is enhanced, and voice is suppressed.

(7) Paging Volume Control. The paging volume control, placarded **PAGING VOL**, controls audio volume to the cabin speakers.

(8) Interphone Volume Control. The interphone volume control, placarded **INTPH VOL**, controls interphone audio volume.

(9) Hot Interphone Switch. The hot interphone switch, placarded **HOT INTPH / OFF**, allows selection of interphone system.

(10) Sidetone Volume Adjustment Port. The pilot and copilot are each provided with a sidetone volume adjustment port, placarded **SIDETONE**, that allows adjusting the volume level of the sidetone.

(11) Interphone Sensitivity Adjustment Port. The pilot and copilot are each provided with an interphone sensitivity adjustment port, placarded **INTPH SENS**, that allows adjustment of the voice actuated interphone activation sensitivity level.

(12) ***DME 1 HOLD*** *Switch-Indicator*. The **DME 1 HOLD** function is controlled by a push on/push off switch indicator, placarded **DME 1 HOLD PUSH / SW**. Pressing the switch-indicator selects the **DME** hold function and causes the switch-indicator to annunciate **ON**.

(13) TACAN DME 1 Volume Control. A TACAN DME 1 volume control, placarded **TAC DME 1 VOL**, controls volume level of TACAN/DME 1 audio.

(14) Ground Communication Switch. A push on/push off switch, placarded **GND COM PWR PUSH ON / OFF**, allows selection of ground comm feature. When selected, the ground comm feature applies power to the number 1 VHF communications transceiver allowing radio communication while on the ground without setting the **BATT** switch or **AVIONICS MASTER PWR** to on.

(15) Marker Beacon Sensitivity/Test Switch. A three-position switch, placarded **MKR BCN 1 & 2 HI / LO / TEST**, selects sensitivity of the marker beacon receivers and test function. When the switch is set to the **HI** position, the marker beacon receivers are set to high sensitivity. When the switch is set to the **LO** position, the marker beacon receivers are set to low sensitivity. When the switch is held in the spring-loaded **TEST** position, the marker beacon annunciator lights will be illuminated.

(16) Marker Beacon Volume Control. The marker beacon volume control, placarded **MKR BCN 1 & 2 VOL**, allows adjustment of the audio volume level of both marker beacon receivers.

(17) ***DME 2 HOLD*** *Switch-Indicator.* The DME 2 HOLD function is controlled by a push on/push off switch-indicator, placarded **DME 2 HOLD PUSH / SW**. Pressing the switch-indicator selects the DME hold function and causes the switch-indicator to annunciate **ON**.

(18) DME 2 Volume Control. A DME 2 volume control, placarded **DME 2 VOL**, controls volume level of DME 2 audio.

(19) Annunciator Brightness Control. A knob, placarded **ANN DIM / PUSH BRT**, which controls the brightness level of the EFIS annunciators, located on the instrument panel above the airspeed indicators, controls annunciator brightness.

(20) Stormscope Control Switch. Lightning activity weather avoidance information, which is displayed on the Electronic Horizontal Situation Indicator's (EHSI) and the MFD, is controlled by a switch placarded **STORMSCOPE CLEAR / ON / OFF**. The **CLEAR** position will remove displayed lightning strike information. When the switch is set to **ON**, lightning strike information will be provided to the displays.

(21) Standby Horizon Power Warning Horn Silence Switch. The standby horizon power warning horn may be silenced by pressing a push-button switch placarded **HORN SILENCE**.

(22) Standby Horizon Power Control Switch. A switch, placarded **ON / OFF / TEST**, controls the standby horizon power system.

(23) Standby Horizon Power Annunciator. The standby horizon power system annunciator, placarded **AUX ARM / AUX ON / AUX TEST**, is used to monitor functional state of the system.

(24) Voice Advisory System (GPAAS) Switch-Indicator. The upper half of the voice advisory system switch-indicator, yellow, is placarded **VOICE OFF**. The lower half of the indicator, red, is placarded **VA FAIL**. Pressing the **VOICE OFF** switch-indicator disables the GPAAS voice advisory and illuminates the **VOICE OFF** indicator light. The **VA FAIL** annunciator light illuminates when the GPAAS fails.

(25) Voice Advisory System (GPAAS) Volume Control. A GPAAS volume control placarded **VOL**, controls the audio volume of the GPAAS advisory/warning messages down to a certain minimum level.

(26) Transponder Selection Switch. A transponder selection switch, placarded **XPNDR ATC / IFF**, allows selection of either the commercial transponder, ATC, or military transponder, IFF.

(27) Air Data Computer Selection Switch. An air data computer selection switch, placarded **AIR DATA, ALL ON 1 / NORM / ALL ON 2**, allows the operation of: both EFIS systems on the number 1 air data computer (**ALL ON 1**) or the number 2 air data computer (**ALL ON 2**). It also allows the operation of one EFIS system on the number 1 air data computer and the other EFIS system on the number 2 EFIS system in the **NORM** position.

3A-7. AM/FM (VHF/UHF) TRANSCEIVER (RT-5000).

The AM/FM (VHF/UHF) transceiver (RT-5000) may be operated in the following frequency ranges:

a. AM/FM Frequencies:

29.7 to 88 MHz
108 to 116 MHz (receive only)
118 to 156 MHz (AM band)
220 to 225 MHz
225 to 400 MHz

b. FM Frequencies:

138 to 174 MHz
403 to 512 MHz
512 to 806 MHz
806 to 960 MHz

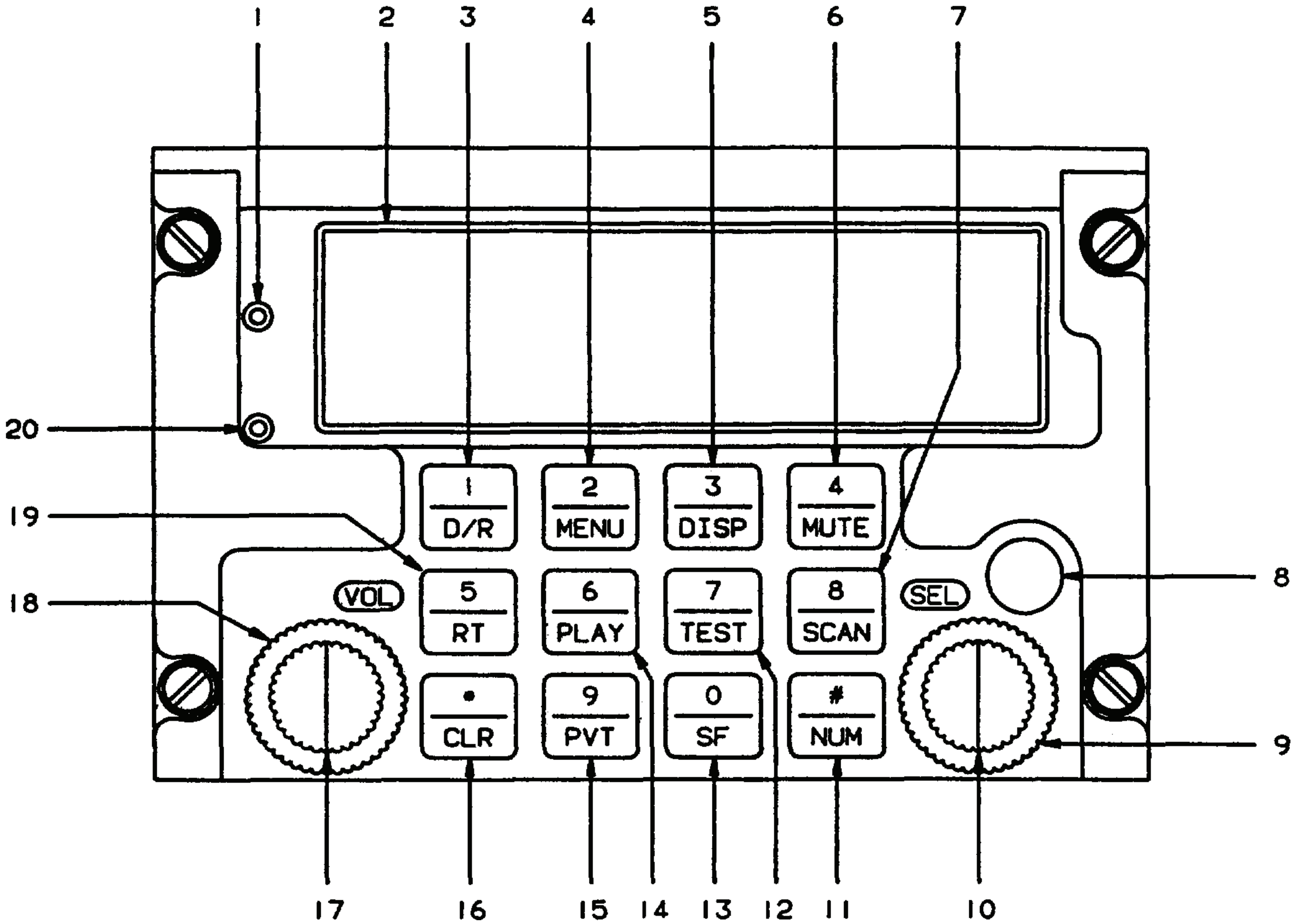
A control-display unit (C-5000) located in the pedestal extension, Figure 2-11, operates the transceiver. The system is powered through a 10-ampere circuit breaker placarded **AM/FM**, located on the right sidewall circuit breaker panel, Figure 2-6.

The transceiver control-display unit can store 350 channels in memory. Frequencies are stored by channel number, alphanumeric identifier assigned by the user or by frequency. Each channel has its own separate transmit and receive frequency, transmit and receive squelch control setting, channel identifier, and channel number.

An audio recorder provides playback of the last 10 seconds of the most recent reception.

c. AM/FM (VHF/UHF) Transceiver Control-Display Unit Controls, Indicators, and Functions. Refer to Figure 3A-2.

(1) Upper and Lower Soft Keys. The upper and lower soft keys are display controls. Depending upon the display page in use, pressing the upper or lower soft key will have the following results.



1. **Upper Soft key**
2. **Display**
3. **Direct/Repeat Or Number 1 Key**
4. **Menu Or Number 2 Key**
5. **Display Or Number 3 Key**
6. **Mute Or Number 4 Key**
7. **Scan Or Number 8 Key**
8. **Data Transfer Port**
9. **Cursor Movement Knob (Outer Knob)**
10. **Cursor Field Values Knob and Enter Button (When Pressed)**
11. **Number Keypad Activation Or # Sign Key**
12. **Test Or Number 7 Key**
13. **Special Function Or 0 Key**
14. **Play Or Number 6 Key**
15. **Private Or Number 9 Key**
16. **Clear Or Asterisk (*) Key**
17. **Active Transceiver Volume Control Knob Or On/Off Switch (When Pressed)**
18. **Monitored Transceiver Volume Control (Outer Knob)**
19. **Receiver/Transmitter Or Number 5 Key**
20. **Lower Soft Key**

Figure 3A-2. AM/FM (VHF/UHF) Transceiver Control-Display Unit

(a) Dim Display Menu Page. Pressing the upper soft key while on the Dim Display Menu page will brighten the fluorescent display. Pressing the lower soft key while on the Dim Display Menu page will dim the fluorescent display.

(b) Pulse/Tone Menu Pages. Pressing the upper soft key while on the Pulse/Tone Menu page selects the tone option. Pressing the lower soft key while on the Pulse/Tone Menu page deselects the tone option.

(c) Squelch Level Menu Page. Pressing the upper soft key while on the Squelch Level Menu page will increase squelch level. Pressing the lower soft key while on the Squelch Level Menu page will decrease squelch level.

(d) Relay Mode Menu Page. Not applicable with one transceiver.

(e) Dual Microphone Mode Menu Page. Not applicable with one transceiver.

(2) Display. This fluorescent display shows system operation.

*(3) Direct/Repeat or Number **1*** Key. Pressing the **D/R** key alternates transceiver system operation between direct and repeat transmit and receive operating modes. On menu pages, key **1** moves backward through them. Use the **1** key also to enter the number 1 when numeric entry is required.

*(4) Menu or Number **2** Key.* Pressing the **MENU** key brings the menu pages up on the display. On menu pages, pressing the **2** key moves forward through them. Use the **2** key also to enter the number 2 when numeric entry is required.

*(5) Display or Number **3** Key.* Pressing the **DISP** key brings up a display page. Use the **3** key also to enter the number 3 when numeric entry is required.

NOTE

MUTE function does not work with only one transceiver installed.

*(6) **MUTE** or Number **4** Key.* Pressing the **MUTE** key temporarily inhibits all monitored receivers, except the active transceiver. Pressing the **MUTE** key alternates audio between mute and normal. Use the **4** key also to enter number 4 when numeric entry is required.

*(7) **SCAN** or Number **8** Key*. Pressing the **SCAN** key will access the scan mode. Use the **8** key also to enter the number 8 when numeric entry is required.

(8) Data Transfer Port. The data transfer port allows uploading and downloading channel programming from a personal computer using remote programmer software. The data transfer port also allows crossfilling channel programming from one C-5000 control-display unit to another.

(9) Cursor Movement Knob (Outer Knob). Turning the cursor movement knob moves the cursor to the desired position.

(10) Cursor Field *Value Knob and Enter Button.* Turning the cursor field value knob changes the value in the cursor field. Pressing the knob enters selection.

*(11) Number Keypad Activation Or **#** Sign Key*. Pressing the **NUM** key activates the numeric keypad for channel or frequency selection. Use the # key also to enter a number sign when required.

*(12) **TEST** or Number **7** Key*. Pressing the TEST key will manually disable the squelch circuit on the active transceiver and will display the transmit frequency if the appropriate page is displayed. Releasing the key will return the transceiver to normal squelch operation. Pressing this key (breaking squelch) facilitates setting receiver volume. Use the **7** key also to enter the number 7 when numeric entry is required.

*(13) Special Function or **0** Key*. Pressing the Special Function (**SF**) key brings up the special function display (not implemented). Use the **0** key also to enter the number 0 when numeric entry is required.

*(14) **PLAY** or Number **6** Key*. Pressing the **PLAY** key will initiate audio playback of recorded audio on selected transceiver. Use the **6** key to enter the number 6 when numeric entry is required.

*(15) Private or Number **9** Key*. Pressing the **PVT** key selects the voice encryption function. Use the **9** key also to enter the number 9 when numeric entry is required.

(16) Clear Or Asterisk (*) Key. Pressing the **CLR** key exits an operation. Use the ***** key also to enter an asterisk when required.

(17) Active Transceiver Volume Control Knob or OnlOff Switch. The active transceiver volume control knob (inner knob) adjusts the volume of the received audio from the active transceiver when turned. Pressing the control knob turns the system on and off.

(18) Monitored Transceiver Volume Control. Turning the monitored transceiver volume control knob (outer knob) adjusts the volume of the monitored transceiver system.

NOTE

Only one transceiver is available (main), so monitored transceiver volume control has no effect.

*(19) Receiver/Transmitter or Number **5** Key.* Pressing the **RT** key will enable or disable a transceiver or guard receiver. After pressing the **RT** key, press the number of the transceiver to enable or disable it. Use the **5** key also to enter the number 5 when numeric entry is required.

d. Display Pages.

(1) Self-Test Page. The Self-Test page will appear at system startup. While displaying this page, the system is performing internal self-tests and is initializing memory. The software version number currently in use displays on this page.

(2) Dim Display Page. Pressing the **MENU** key will bring up the Dim Display page. Press the lower soft key to dim the display or the upper soft key to brighten the display. Pressing the **CLR** key will return the display to the Control Display Alpha page.

NOTE

Pressing the on/off knob briefly will return the display to maximum brightness.

(3) Off Page. Pressing the on/off knob for at least 4 seconds will bring up the off page. The off page will flash for 4 additional seconds, warning the operator that the system is turning off. After these 4 seconds have elapsed, the system will turn off.

NOTE

Pressing the CLR key will always bring display back to the control display alpha page and will put the cursor under the channel number.

(4) Control Display Alpha Page. Pressing the **CLR** key will bring up the control display alpha page. This display shows frequency by alphanumeric identifier. The control display alpha page shows the status of the main transceivers, guard receivers, and which transceiver and channel the primary microphone will use. Refer to Figure 3A-3. This page displays tone, transmitter power level, and repeater/direct information and allows changes on the page.

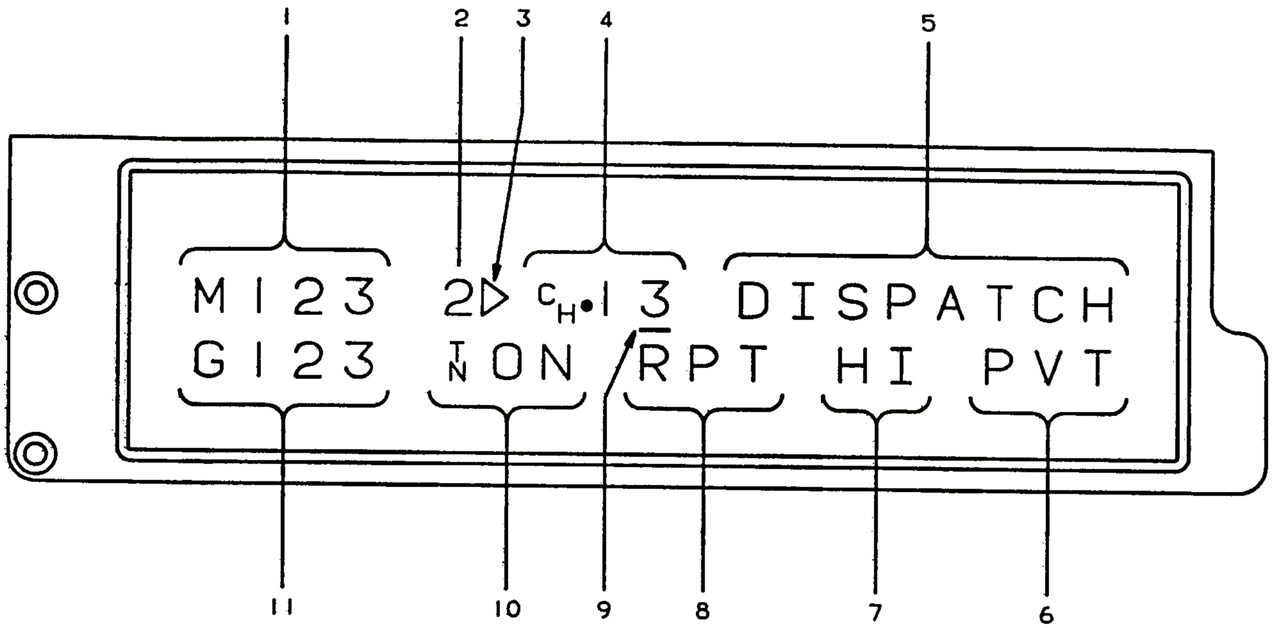
(5) Control Display Frequency Page. To bring up the control display frequency page, press the **DISP** until it appears. The control display frequency page is identical to the control display alpha page, except that it displays the frequency as the actual frequency number instead of an alphanumeric identifier.

(6) System Display Page. To bring up the system display page from the control display alpha page, press the **DISP** until it appears. To bring up the system display page from any other page, press the **CLR** key as many times as is necessary until the control display alpha page appears. Then press the **DISP** as many times as is necessary until the system display page appears. The following operations can be performed from the system display page.

1. Selecting an active transceiver.
2. Disabling and enabling a transceiver.
3. Selecting the preset channel.
4. Selecting an active guard.
5. Changing the guard preset channel.
6. Disabling and enabling guards.

(7) Active/Standby Display Alpha Page. To bring up the active/standby display alpha page from the control display alpha page, press the **DISP** key until it appears. To bring up the Active/Standby Display page from any other page, press the **CLR** as many times as is necessary until the control display alpha display page appears. Press the **DISP** key as many times as is necessary until the Active/Standby Display Alpha page appears. Use the Active/Standby Display Alpha page to change the active/standby transceiver or preset channel number.

(8) Active/Standby Display Frequency Page. To bring up the active/standby display frequency page from the control-display alpha page, press the **DISP** key until it appears. To bring up the active/standby frequency display page from any other page, press the **CLR** key as many times as necessary until the control display alpha page appears. Press the **DISP** key until the active/standby frequency page appears. The active/standby display frequency page is identical to the active/standby display alpha page, except that the frequency displays as the actual frequency number instead of an alphanumeric identifier.



1. **Available Main Transceiver Numbers**
2. **Active Main Transceiver Number**
3. **Transmit Indicator**
4. **Channel Number**
5. **Alphanumeric Frequency Identifier**
6. **Encryption Annunciator**
7. **Transceiver Power Level Indicator**
8. **Transceiver Repeat Or Direct Indicator**
9. **Cursor**
10. **Receive And Transmit Subaudible Tone Status**
11. **Transceiver Numbers With Operating Guard**

Figure 3A-3. AM/FM (VHF/UHF) Transceiver Control Display Alpha Page

(9) Squelch Level. The squelch level menu page allows changing the preset squelch level. Press the **MENU** key to bring up the squelch level menu page. To increase squelch level one increment, press the upper soft key one time. To increase squelch level more than one increment, hold down the upper soft key until the desired number of increments displays. The arrow at the left of INC will flash for each increment. To decrease squelch level one decrement, press the lower soft key one time. To decrease squelch level more than one decrement, hold down the lower soft key until the desired number of decrements displays. The arrow at the left of DEC flashes for each decrement. Press the **CLR** key to return to the last display page shown before going to the squelch level menu page.

(10) Program Presets Page. The program presets page allows the user to add, edit, or delete preset channels. Before programming, prepare a list with the following information for all channels to be programmed as follows:

1. Channel number.
2. Alphanumeric identifier.
3. Transmit and receive frequencies.
4. Transmit and receive tones.
5. Transmit and receive channel discretes.

6. Transmit power status.

(11) Recorded Audio Playback. The system automatically records the first 10 seconds of received audio from each transceiver and will reset and start recording again with each squelch break. To play a recording, use the following procedure.

*(12) **PLAY** key – Press*. A prompt will appear asking which transceiver's recording you want played back.

(13) Numeric Keypad – Press the number of the transceiver you want played back.

1. **CLR** – Press when playback is complete to return to a display page.

e. Operating Procedures.

(1) Initial Operating Procedure.

1. On/off switch – Press. Self-test page will appear. When self-test is complete the control-display alpha page or the last display page shown before system shutdown will appear.
2. **MENU** key – Press.
3. Upper and lower soft keys – Press as required to adjust display brightness.

NOTE

Briefly pressing the on/off knob will return display to maximum brightness.

4. **CLR** key **–** Press.
5. Cursor movement control knob and cursor field value knob – Set channel or frequency as desired.

(2) Programming Preset Channels.

(a) Initial Preset Channel Programming Procedure.

1. **MENU** key – Press until program presets menu page appears.
2. Enter knob – Press. Preset password page will appear.
3. Four number preset password (Password is 2222) – Enter. Preset channel page will appear.
4. Enter knob – Press. Add/edit/ delete page will appear.

(b) Adding A Preset Channel.

1. Number **1** key – Press to add a channel.
2. Cursor movement control knob – Turn to place cursor under the digit to be changed.
3. Cursor field value knob – Turn to select desired number.
4. Number **2** key – Press. Channel transceiver (R/T SYS) # page will appear.
5. Cursor field value knob – Turn to display transceiver associated with selected channel.
6. Number **2** key – Press. ALPHA ID page will appear.
7. Cursor movement control knob and cursor field value knobs – Set desired alphanumeric values in spaces.
8. Number **2** key – Press to select the entered identifier. Receive Frequency (RX FREQ) page will appear.
9. **#** Key – Press.
10. Keypad – Enter frequency.
11. Enter knob – Press.
12. Number **2** key – Press to select entered receive frequency. Receive Tone (RX TONE) page will appear.
13. Cursor movement knob – Place cursor under last dot.
14. Cursor field value knob – Set desired number.
15. Number **2** key – Press to select entered receive tone. MODULATION TYPE page will appear.

16. Cursor field value knob – Select AM or FM. Transmit frequency (TX FREQ) page will appear.

17. **#** Key – Press.

18. Keypad – Enter frequency.

19. Enter knob – Press.

20. Number **2** key – Press to enter transmit frequency. Transmit Tone (TX TONE) page will appear.

21. Cursor movement knob – Place cursor under last dot.

22. Cursor field value knob – Set desired value.

23. Number **2** key – Press to select transmit tone. Advanced features page will appear.

24. Number **2** key – Press if advanced features are not required and proceed to step 52.

25. Number **3** key – Press if advanced features are required. DISPLAY FREQ page will appear.

NOTE

If NO is selected, asterisks (*) will appear for the preset channel frequency during operation.

26. Cursor value knob – Turn to display YES or NO.

27. Number **2** key – Press to select option. Receive only (RX ONLY) page will appear.

28. Cursor value knob – Turn to display YES or NO.

29. Number **2** key – Press to select option. Receive type (RX TYPE) page will appear.

30. Cursor value knob – Turn to select transceiver type.

NOTE

Only the RT-5000 transceiver is available.

31. Number **2** key – Press to select option. Receive Channel Discrete (RX CMDS) page will appear.

NOTE

Channel discretes are a combination of five electronic switches that can be programmed to be activated with each guard or main channel (transmit can be different from receive). There are five transmit and receive discretes assigned to each transceiver. Outputs control external interfaces such as antenna switching, external encoder or decoder enable/disable functions, or any external function or equipment switching associated with a given channel.

32. Cursor movement knob – Place cursor under appropriate space. Switch #1 is in far right position and switch #5 is in far left.

33. Cursor value knob – Turn to select value for each switch (1 = ground, 0 = open circuit).

34. Number **2** key – Press to select switch configuration. Transmit Channel Discrete (TX CMDS) page will appear.

35. Cursor movement knob – Place cursor under appropriate space. Switch **#1** is in far right position and switch **#5** is in far left.

36. Cursor value knob – Turn to select value for each switch (1 = ground, 0 = open circuit).

37. Number **2** key – Press to select switch configuration. TX PWR (transmit power) page will appear.

38. Cursor field value knob – Turn to select HI or LO.

39. Number **2** key – Press to select option. Second Intermediate Frequency Injection (2ND IF INJECTION) page will appear.

NOTE

Intermediate Frequency (IF) injection is a function that eliminates interfering signals from the applicable IF range.

40. Cursor field value knob – Turn to select HI or LO.

41. Number **2** key – Press to select option. Third Intermediate Frequency Injection (3RD IF INJECTION) page will appear.

42. Cursor field value knob – Turn to display HI or LO**.**

43. Number **2** key – Press to select option. Receive Audio Phase (RX AUDIO PHASE) page will appear.

NOTE

Receive audio phase is used to reverse the phase of a received signal that has the wrong phase due to encryption processing.

44. Cursor Value knob – Turn to select audio phase setting of 0 or 180.

45. Number **2** key – Press to select option. Receive Bandwidth (RX BANDWIDTH) page will appear.

46. Cursor field value knob – Turn to set desired bandwidth from the following options:

0 = Standard BW	14 kHz
1 = Narrow BW	9 kHz
2 = Wide BW	35 kHz
3 = Extra wide BW	70 kHz

47. Number **2** key – Press to select option. Transmit Deviation (TX DEVIATION) page will appear.

48. Cursor field value knob – Turn to set desired transmit deviation from the following options:

0 = Standard BW	5 kHz
1 = Narrow BW	2.5 kHz
2 = Wide BW	5.6 kHz
3 = Extra wide BW	5.6 kHz

49. Number **2** key – Press to select option. Transmit Audio Phase (TX AUDIO PHASE) page will appear.

NOTE

Transmit audio phase is used to reverse the phase of an output signal to provide correct signal interface.

50. Cursor field value knob – Turn to display desired audio phase setting.

51. Number **2** key – Press to select option. Load/review page will appear.

52. Number **1** key – Press to load preset channel selections into memory or:

53. Number **2** key – Press to review preset channel selections. Add/ edit/delete page will appear. Continue loading next preset channel if desired.

54. **CLR** key – Press to return to preset channel page.

55. Number **1** key – Press to return to PROGRAM PRESETS page.

(c) Editing A Preset Channel.

1. Initial preset channel programming procedures – Perform if necessary to bring up the ADD / EDIT / DELETE display page.

2. Number **2** key – Press to edit channel. Follow procedures for adding a preset channel starting with step 2, but changing only the items needing to be edited.

(d) Deleting A Preset Channel.

1. Initial preset channel programming procedures – Perform if necessary to bring up the ADD/EDIT/DELETE display page.

2. Number **3** key – Press to delete a channel. The delete channel page will appear with a preset channel number.

3. Cursor field value knob – Turn to select preset channel to delete.

4. Number **2** key – Press to delete the selected channel.

(3) Shutdown Procedure.

1. On/off knob – Press. The off page will appear and flash to warn the operator that the system is turning off.

2. After 4 seconds, the system will turn off.

3A-8. VHF COMMUNICATIONS TRANSCEIVER.

Refer to Chapter 3, Paragraph 3-4.

3A-9. HF COMMUNICATIONS TRANSCEIVER.

Refer to Chapter 3, Paragraph 3-3.

3A-10. AIRBORNE TELEPHONE SYSTEM.

The airborne telephone system consists of a remote transceiver, a telephone base and handset located in the passenger compartment, and an antenna.

The transceiver operates in the UHF band at frequencies of 454.675 to 454.975 MHz (receiver section) and 459.675 to 459.975 megahertz (transmitter section). Transmitter power output is a nominal 10 watts. The maximum operating altitude is a nominal 51,000 feet. Although the theoretical maximum range at 31,000 feet altitude is 220 nautical miles, the range is essentially limited to line-of-sight, and may be reduced depending upon the altitude of the aircraft, weather, type of terrain, and the location and altitude of the ground transmitter. The system is protected by a 5-ampere **RADIO PHONE** circuit breaker located on the right sidewall circuit breaker panel, Figure 2-6.

a. Airborne Telephone System Controls, Indicators, and Functions. Refer to Figure 3A-4.

(1) Telephone Base Unit. The following items are located on the telephone base unit.

(a) Hookswitch – When pressed by placing handset in cradle, puts system in standby mode and deactivates transmitter.

*(b) Intercom Lamp (**IC**)* – While handset is in cradle, illuminates to indicate power is on. When handset is removed from cradle, illuminates to indicate system is in intercom mode.

*(c) Direct Dial Lamp (**D/DIAL**)* – Illuminates to indicate an Air/Ground Radiotelephone Automated Service (AGRAS) station with direct dial service has been selected.

*(d) **HF / BELL OFF / PHONE** Switch* – Selects between HF and PHONE modes. Center position selects ringer **ON** or **OFF**.

*(e) Transmit Lamp (**TX**).* Illuminates to indicate transmitter is activated.

(2) Telephone Handset. The following items are located on the telephone handset.

*(a) **PTT** Switch* – When system is in HF mode, it functions as a push-to-talk/release-to-receive switch. When the handset is in cradle, it functions as a release button to unlock handset from base unit.

(b) Numerical Keys – Press to select channels and telephone numbers.

*(c) Enter (**#**) Key* – When pressed, immediately enters a channel number or telephone number.

(d) Clear (✶) Key – When pressed, clears input in progress without entering.

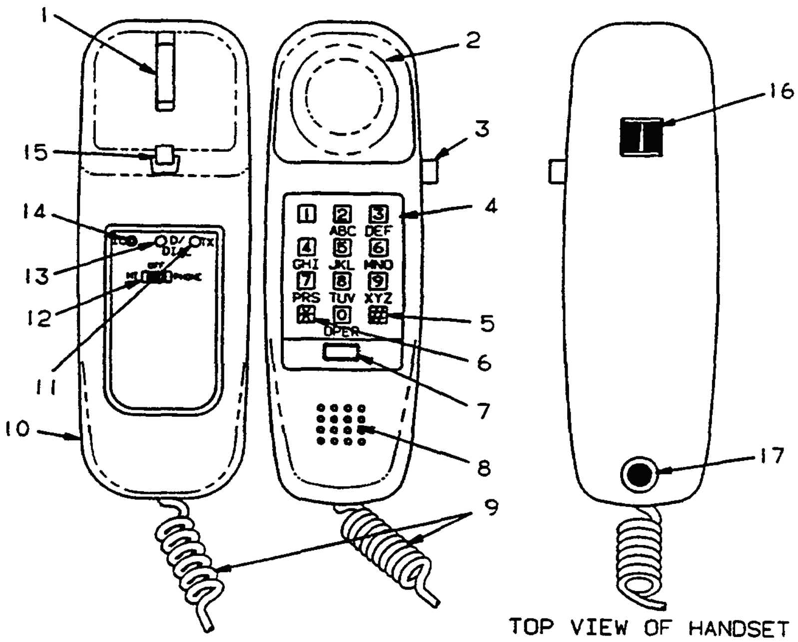
(e) Hookswitch – When pressed, puts system in standby mode and deactivates transmitter.

(f) Volume Control – Rotates to adjust volume of handset speaker.

b. Airborne Telephone System Operation. The airborne telephone system may be used either in HF mode or in PHONE mode. The HF mode permits the handset to be used as a microphone/speaker in conjunction with the aircraft's HF communications set to provide standard two-way radio communications in the HF band. The PHONE mode provides communications very similar to ground-based telephone service, operating on 13 channels (12 telephone channels plus 1 ground-to-air calling channel).

Telephone calls may be placed either with assistance from an operator at a manned ground station or direct dialed through AGRAS stations. When the handset is removed from the base, the set will automatically scan each channel for ground stations in range of the aircraft and will select one in the following order of preference.

1. Idle AGRAS stations.



1. **Base Unit Hookswitch**
2. **Handset Speaker**
3. **Press-to-Talk Switch (PTT)**
4. **Numerical Keys**
5. **Enter Key**
6. **Clear Key**
7. **Handset Hookswitch**
8. **Noise Canceling Microphone**
9. **Coiled Cord**
10. **Base Unit**
11. **Transmit Lamp (TX)**
12. **HF Bell Off Phone Switch**
13. **Direct Dial Lamp (D/DIAL)**
14. **Intercom Lamp (IC)**
15. **Handset Locking Post**
16. **Volume Control**
17. **Noise Canceling Tube**

Figure 3A-4. Airborne Telephone

2. Idle manned ground stations.

3. Busy AGRAS stations.

4. Busy manned ground stations.

5. Busy AGRAS stations with queuing capability.

If no ground station is available, a busy signal will sound in the handset.

(1) Air to Ground Calling.

1. Handset – Remove from base.

2. Handset – Listen to audio to determine which one of the following dialing procedures to use.

(a) Dial tone (D/DIAL light illuminated).

1. Phone Number – Enter using numeric keys.

2. Handset – Listen for queue or camp on tone.

3. Handset – Hang up and wait for phone to ring.

NOTE

Phone will ring when first usable station is received.

4. Handset – Pick up when phone rings. Call is placed automatically.

NOTE

Press ✶ key to cancel queue if desired.

(b) High Pitched Tone. No direct dial station is available. The strongest operator assisted station has been selected.

1. **OPER** Switch – Press to call mobile operator.

2. When mobile operator responds:

a. Give billing information.

b. Give telephone number that you are calling or:

c. Place telephone in queue (camp on) and wait for direct dial station.

(c) Voice Conversation. No direct dial station is available. The strongest operator assisted station has been selected and its channel is in use.

1. Handset – Hang up and try later or:

2. Place telephone in queue (camp on) and wait for direct dial station.

3A-11. EMERGENCY LOCATOR TRANSMITTER (ELT 110-4).

NOTE

On aircraft serial numbers 92-3327, 92-3328, and 92-3329, an access hole with a spring-loaded cover is located in the fuselage skin adjacent to the transmitter, enabling a downed pilot to manually initiate or terminate operation, or reset the ELT to an armed mode.

a. Description. An automatic or manually activated ELT, Figure 3A-5, is located in the left side of the aft fuselage. The associated antenna is mounted on top of the aft fuselage. The transmitter contains a G switch that automatically activates the transmitter following a velocity change of 3.5 feet per second. When activated, the ELT will radiate omnidirectional radio frequency signals on the international distress frequencies of 121.5 and 243.0 megahertz. The radiated signal is modulated with an audio swept tone. Internal batteries provide transmitter operation for a minimum of 50 hours at –20 ºC.

b. Remote Switch and Indicator Light. The remote switch and indicator light are located on the left sidewall next to the free air temperature indicator, Figure 2-7. The ELT annunciator, placarded **XMT**, illuminates to indicate that the ELT is transmitting. The remote switch is placarded **ON / ARM**.

(1) ***ON*** – Initiates emergency signal transmissions for test or for emergency purposes.

(2) ***ARM*** – Used to arm the ELT or reset it after an accidental activation.

c. Normal Operation. During normal operation the remote switch is in the **ARM** position.

d. Emergency Operation. Moving the remote switch to the **ON** position will manually activate the ELT.

e. Resetting the ELT. If the ELT is activated accidentally, it will need to be reset. Do this by moving the remote switch up to the **ON** position and holding it there for 1 second, then immediately rocking it down to the **ARM** position, then releasing the switch.

3A-12. COCKPIT VOICE RECORDER SYSTEM.

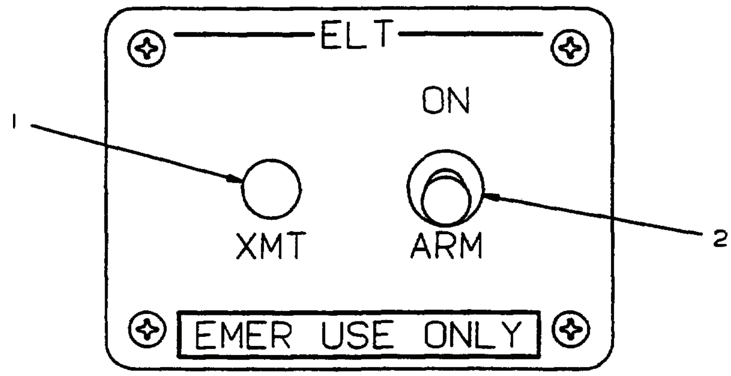
a. Description. The cockpit voice recorder system is a solid-state system consisting of a cockpit voice recorder and a control unit, Figure 3A-6. The cockpit voice recorder system provides four separate channels for voice recording which originate at the pilot's audio amplifier, the copilot's audio amplifier, the aural annunciator audio amplifier, and the area microphone in the cockpit. The cockpit area microphone is strategically located to pick up cockpit voice signals. The control unit (containing the preamplifier, **TEST** switch, and **ERASE** switch) is located in the pedestal extension, Figure 2-11. The cockpit voice recorder system is protected by a 5-ampere circuit breaker placarded **VOICE RCDR**, located on the right sidewall circuit breaker, Figure 2-6.

(1) Cockpit Voice Recorder – The cockpit voice recorder records all voice signals transmitted or received by crew members for a maximum period of 30 minutes continuous operation. After 30 minutes of continuous operation the voice recordings are erased. The cockpit voice recorder is housed in an orange equipment case that is designed to protect the recordings from damage resulting from an accident.

b. Cockpit Voice Recorder Controls, Indicators, and Functions.

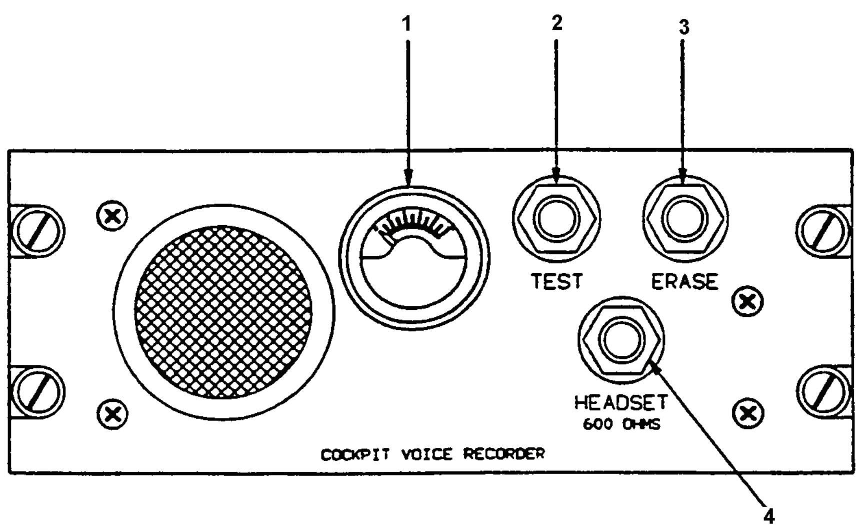
(1) Test Meter. The test meter provides an indication of the relative strength of voice signals coming from the cockpit microphone or audio amplifiers.

(2) ***TEST*** *Switch.* A push-button switch placarded **TEST** provides a means of testing the area microphone channel.



1. Transmit Indicator Light
2. ON / ARM Switch

Figure 3A-5. Emergency Locator Transmitter Control Panel



1. Test Meter
2. TEST Switch
3. ERASE Switch
4. HEADSET Jack

Figure 3A-6. Cockpit Voice Recorder Control Panel

(3) ***ERASE*** *Switch.* A push-button switch placarded **ERASE** is used to erase all recordings after a routine flight. The **ERASE** switch will only work when the weight of the aircraft is on the landing gear. To prevent accidental erasures, a time-delay circuit makes it necessary to hold the **ERASE** switch pressed for 2 seconds before the erasure process will begin.

(4) ***HEADSET*** *Jack.* A jack placarded **HEADSET 600 OHMS** allows playback of all four recording channels simultaneously.

Section III. NAVIGATION

3A-13. NAVIGATION EQUIPMENT GROUP DESCRIPTION.

The navigation equipment group provides the pilot and copilot with instrumentation required to establish and maintain an accurate flight course and position, and to make an approach on instruments under instrument meteorological conditions. The navigation configuration includes equipment for determining attitude, position, destination range and bearing, heading reference, and groundspeed.

3A-14. AUTOMATIC FLIGHT CONTROL SYSTEM (KFC 400C).

a. Description. The automatic flight control system provides fully digital, dual channel, fail passive operation in flight director, autopilot, yaw damper, and trim functions.

The pilot can couple the left or right EFIS to either automatic flight control system for control of the aircraft.

The dual flight control computers provide digital processing of heading, navigation, and air data information to satisfy the pilot's requirements. The data is presented to the pilots on the altitude and vertical speed indicators and EFIS indicators.

The flight control system displays heading, course, radio bearing, pitch and roll attitude, barometric altitude, selected alert altitude, radio altitude, short and long range navigation, course deviation, glideslope deviation, to-from indication, TACAN distance and course indications, and VOR/DME distance information. Display of weather radar and lightning sensor system information on the EHSI is also provided.

Lighted annunciators denote selected flight mode, altitude alert, decision height, and go-around mode engagement. Pitch, roll steering commands, and heading are displayed on the Electronic Attitude Display Indicators (EADI).

The pilot's and copilot's symbol generators are the focal point of information flow in the systems. The symbol generator converts information to video and deflection formats required by the EADI and EHSI displays, and provides analog steering information to the flight director/autopilot interfaces.

When engaged and coupled to the flight director commands, the flight control system will control the aircraft using the same commands displayed on the EADI. When engaged and not coupled to the flight director commands, manual pitch and roll commands may be inserted using the Control Wheel Steering (CWS) switch on the pilot's or copilot's respective control wheel or the autopilot pitch wheel and turn knob located on the pedestal extension.

The digital automatic flight control system consists of the following components:

1. Two autopilot/flight director computers (KCP 420).
2. Two air data computers (KDC 481).
3. Two altitude and vertical speed indicators (KAV 485).
4. Five primary servos (KSA 470). They are aileron, rudder, elevator, rudder trim, and elevator trim.
5. One autopilot controller (KMC 440).
6. Two autopilot monitors (KMC 440).
7. Two gyro adapters (KDA 430).
8. Two vertical gyros (KVG 350).
9. Two directional gyros (KCS 305).
10. Two rate turn gyros (KRG 332).
11. Two mode selectors (KMS 446).
12. Two EHSI (ED-551A).
13. Two EADI (ED-551A).
14. Two EFIS control panels (CP-467).

b. Autopilot/flight Director Computers (KCP 420). The autopilot/flight director computers provide all flight director and autopilot command computations as well as safety monitoring functions. The computers are fully digital and employ dual channels for command computation. Each calculation is computed separately and simultaneously by each channel, with the results compared for consistency by a third channel devoted to system monitoring. The computers are fail passive to prevent the possibility of servo overcontrol by both disengaging the affected servo motor clutch and shutting off motor drive power upon detecting a fault. The system can either disengage affected autopilot control axes individually or, if necessary, shut down the entire flight director/autopilot system. The flight computers also generate audio alerts if the autopilot disengages or trim fails.

c. Air Data Computers (KDC 481). The air data computer processes pitot and static pressure and air temperature inputs, and supplies the processed information to the flight computer and the altitude/vertical speed indicator. The flight computers also provide the air data necessary for the flight management system to provide manual VNAV guidance and automatic three dimensional navigation. The air data computers use the altitude/vertical speed indicators as part of the basic system.

d. Altitude/Vertical Speed Indicators (KAV 485). The air data computers drive the altitude, vertical speed, and density altitude displays on the altitude/vertical speed indicators. The altitude indicator is a digital counter drum pointer style indicator and is combined in the same instrument with a vertical speed indicator. The instrument also provides altitude pre-selection, alerting, and vertical speed pre-selection.

(1) Altitude/vertical Speed Indicator Controls, Indicators, and Functions. Refer to Figure 3A-7.

(a) Inches of Mercury/Millibar Push-button Selector Switch. The inches of mercury/millibar push-button selector switch alternates calibration of the altimeter setting display between inches of mercury (IN HG) and millibars (MB), as annunciated.

(b) Altimeter Scale (hundreds of feet) and Indicator Needle. The altimeter scale and indicator needle display altitude information derived by the air data computer. The digital portion of the display provides altitude resolution to within 20 feet when the aircraft's vertical speed is less than 1000 feet per minute, and to within 100 feet when vertical speed is greater than 1000 feet per minute.

(c) Altitude ALERT Annunciator. The altitude alert annunciator illuminates when the aircraft's current altitude is within 300 to 1000 feet of the value specified in the altitude pre-select display. Upon reaching the selected altitude, the altitude annunciator illuminates again, briefly. An aural alert sounds upon illumination of the annunciator at 1000 feet before and 300 feet outside the selected altitude.

(d) Altitude Select/Density Altitude Display. The altitude select/density altitude display provides a continuous display of selected altitudes for altitude alerting and flight director capture and tracking, and momentary display of current density altitude derived by the air data computer. Pre-selected altitudes are displayed in 100-foot increments when selected by the altitude/vertical speed indicator controls, and in 10-foot increments when selected through the flight management system. The current density altitude will be displayed for approximately 5 seconds at the end of the air data systems preflight test function. Pressing the **PUSH BARO TEST** push button twice in rapid succession changes the display to density altitude at any time.

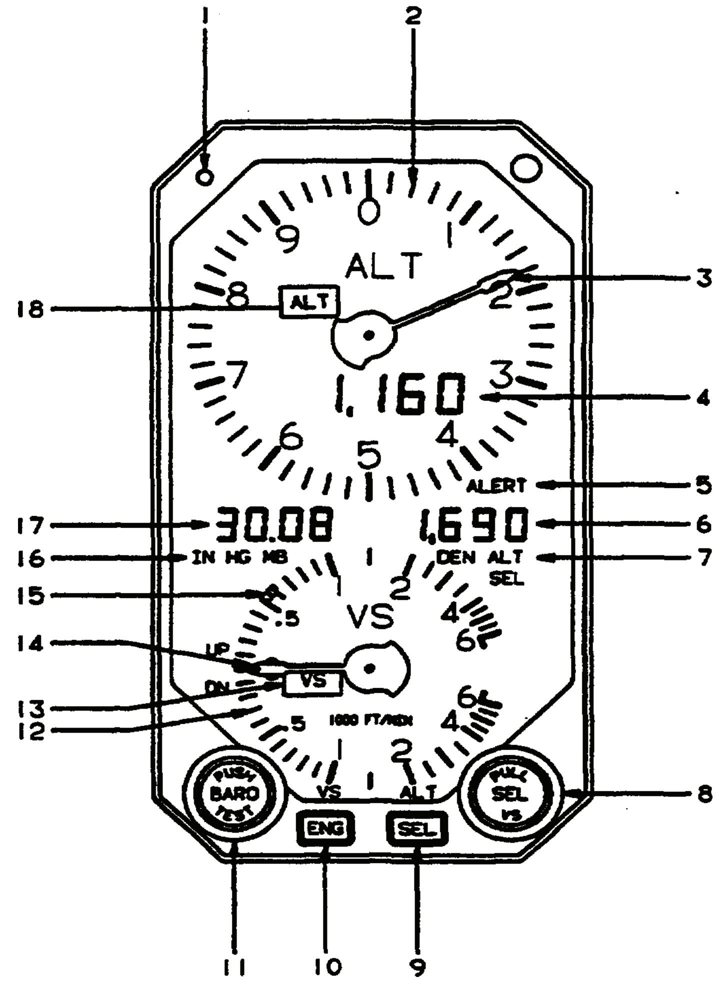
(e) Altitude Select/Density Altitude Annunciator. The altitude select annunciator, **ALT SEL**, or density altitude annunciator, **DEN ALT**, will illuminate to show which information is being displayed.

(f) Altitude/Vertical Speed Pre-select Control. The altitude/vertical speed pre-select control uses dual concentric knobs to control altitude and vertical speed pre-selection. To pre-select altitude, the smaller knob should be pressed to ensure that it is in the inner position. Rotating the smaller knob adjusts the pre-selected altitude in 100-foot increments, with automatic rollover to higher values. The outer knob adjusts altitude in 1000-foot increments. Altitudes may also be pre-selected through the flight management system.

Pulling the smaller knob to its outer position initializes the vertical speed marker, synchronizing it with the last vertical speed selected and references the control knob to vertical speed. The smaller knob adjusts selections in 100 foot per minute increments with automatic rollover. The larger knob adjusts selections in 1000 foot per minute increments.

(g) Altitude Select Key. The altitude select key, placarded **SEL**, is the same as the altitude select key on the flight director mode selector. When pressed, the altitude select key engages the flight director's altitude arm function in coordination with the digital altitude pre-select display on the altitude/vertical speed indicator.

(h) Vertical Speed Engage Key. The vertical speed engage key, placarded **ENG**, is the same as the vertical speed key on the flight director mode selector. When pressed, the vertical speed engage key causes the flight director to command the aircraft to climb or descend at the rate indicated by the vertical speed marker on the vertical speed indicator.



1. Inches of Mercury/Millibar Push-Button Selector Switch
2. Altimeter Scale (Hundreds or Feet)
3. Altimeter Indicator Needle
4. Altitude Display
5. Altitude ALERT Annunciator
6. Altitude Select/Density Altitude Display
7. Altitude Select/Density Altitude Annunciator
8. Altitude/Vertical Speed Preselect Control
9. Altitude Select Key
10. Vertical Speed Engage Key
11. Altimeter Setting Selector/ Push To Test Control
12. Vertical Speed Indicator Scale
13. Vertical Speed Invalid Annunciator
14. Vertical Speed Indicator Needle
15. Preset Vertical Speed Selection Indicator
16. Inches of Mercury/Millibar Annunciator
17. Altimeter Setting Display
18. Altimeter Invalid (ALT) or FAIL Annunciator

Figure 3A-7. Altitude/Vertical Speed Indicator

NOTE

If the vertical speed selection indicator on the vertical speed indicator scale is in view when vertical speed hold is engaged, the pre-selected vertical speed will be commanded. If the indicator is not in view when vertical speed is engaged, the aircraft's current commanded vertical speed will be maintained and the indicator will come into view synchronized with the vertical speed indicator pointer.

(i) Vertical Speed Indicator Scale. The vertical speed indicator scale displays instantaneous vertical speed with 100-foot resolution for values less than 1000 feet per minute up or down, and with 500 feet per minute resolution for larger values.

(j) Vertical Speed Invalid Annunciator. Illumination of the vertical speed invalid annunciator placarded **VS**, indicates an invalid display.

(k) Vertical Speed Indicator Needle. Moves around vertical speed scale to indicate vertical speed.

(l) Preset Vertical Speed Selection Indicator. Indicates selected vertical speed.

(m) Inches of Mercury/Millibar Annunciator. Indicates units of pressure measurement for altimeter setting in HG or MB.

(n) Altimeter Setting Display. Displays altimeter setting in millibars or inches of mercury.

(o) Altimeter Invalid (ALT or FAIL) Annunciator. The altimeter invalid annunciator illuminates ALT or FAIL to indicate invalid altimeter information.

e. Autopilot Servo Actuators (KSA 470). To manipulate trim surfaces, as well as elevator, aileron, and rudder controls, the autopilot employs servo actuators installed in the aircraft's fuselage. Each servo assembly includes a drive motor, clutch mechanism, and mounting bracket.

f. Autopilot Controller (KMC 440). The autopilot controller provides selection of autopilot, yaw damper, half bank, and soft ride functions. In addition the autopilot also includes roll, pitch, and yaw axis annunciators that illuminate to indicate failure of individual control axes, and roll and vertical trim controls. To engage autopilot modes press the corresponding control key. To disengage, press the key a second time.

NOTE

The autopilot cannot be activated if the flight director is not operating properly.

Annunciator lamps illuminate above the selector keys and on the EADI to indicate autopilot mode of operation. In the event of system failure, annunciators corresponding to the autopilot and yaw damper will flash for approximately 5 seconds before extinguishing. An alert tone will sound upon disengagement.

(1) Autopilot Controller Controls, Indicators, and Functions. Refer to Figure 3A-8.

(a) Autopilot Engage/Disengage Push-Button Selector Switch. Pressing the autopilot engage/disengage push-button selector switch, placarded **AP**, initiates autopilot control of the pitch, roll, and yaw axes, provided the system meets preflight test criteria. The yaw damper and flight director, if not previously engaged, engage automatically upon autopilot activation. In the absence of any selected flight director modes, the autopilot will follow basic roll and pitch attitude hold commands synchronized to the aircraft attitude current upon activation. Pressing the autopilot key a second time cancels its operation. The flight director and yaw damper will remain engaged until they are canceled individually.

(b) Autopilot Engaged Annunciator. Illumination of the autopilot annunciator, placarded **AP**, indicates that the autopilot is engaged.

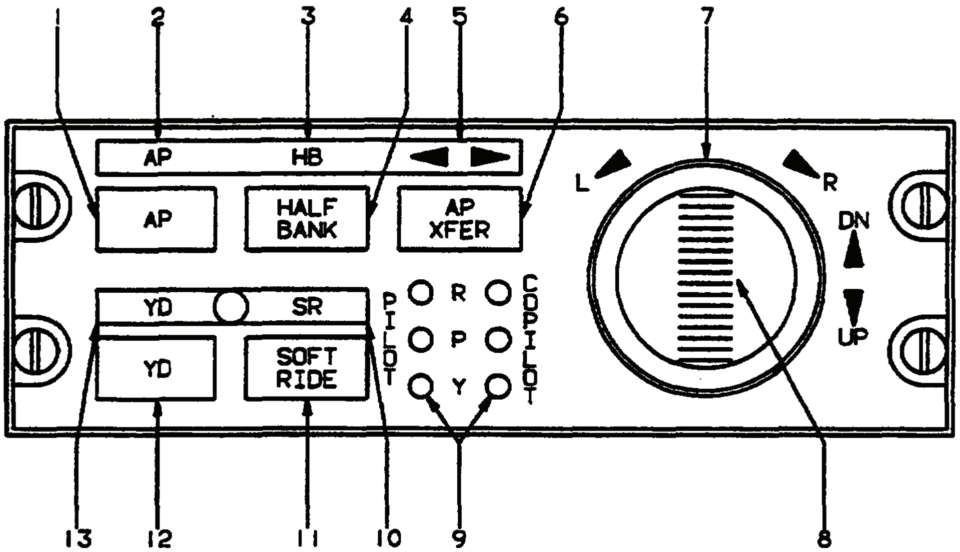
(c) Half Bank Mode Annunciator. Illumination of the half bank mode annunciator, placarded **HB**, indicates that the half bank mode has been selected and is engaged.

(d) Half Bank Mode Push-Button Selector Switch. Pressing the half bank mode push-button selector switch, placarded **HALF BANK**, reduces the autopilot maximum roll attitude command to one half the normal limit. Roll commands of lesser magnitude are not affected. **HALF BANK** may be engaged in conjunction with any flight director tracking mode with the exception of approach. **HALF BANK** may be employed at the same time as approach arm, but will cancel automatically upon initiation of the approach capture sequence.

(e) Autopilot Left/Right System Transfer Indicator. The autopilot left/right system transfer indicator consists of a left and right illuminated arrow. The indicator, located above the autopilot transfer (**AP XFER**) switch, illuminates to show which side is controlling the aircraft.

(f) Autopilot Left/Right System Transfer Push-Button Selector Switch. Pressing the autopilot left/ right transfer push-button selector switch, placarded **AP XFER**, changes which EFIS system (left or right) controls the aircraft.

(g) Roll/Roll Rate Command Control Knob. The roll/roll rate command control knob, placarded **L** and **R**, is a rotary, return-to-center control knob. Turning the knob modifies the flight director's reference attitude during operations in roll attitude hold. Turning the knob in either direction cancels any selected flight director horizontal mode and engages roll attitude hold. Operating the roll attitude control does not affect arm operations in nav or approach modes, nor does it affect flight director vertical modes, with the exception of glideslope, which it cancels along with approach.



1. **Autopilot Engage/Disengage Push-button Selector Switch**
2. **Autopilot Engaged Annunciator**
3. **Half Bank Mode Annunciator**
4. **Half Bank Mode Push-button Selector Switch**
5. **Autopilot Left/Right System Transfer Indicator**
6. **Autopilot Left/Right Transfer Push-button Selector Switch**
7. **Roll/Roll Rate Command Control Knob**
8. **Vertical Trim Thumbwheel Control**
9. **Pilot/Copilot Roll, Pitch, and Yaw Axis Failure Annunciators**
10. **Soft Ride Mode Annunciator**
11. **Soft Ride Mode Push-button Selector Switch**
12. **Yaw Damper Engage/Disengage Push-button Selector Switch**
13. **Yaw Damper Engaged Annunciator**

Figure 3A-8. Autopilot Controller

Roll rate commands increase in direct proportion to the degree of roll attitude control knob deflection, up to the flight control system's maximum commandable roll rate or attitude. Releasing the knob allows it to return automatically to its center position. The flight director will command the aircraft to maintain the existing roll attitude. Roll attitudes of less than 2° of bank angle will revert to wings-level flight.

(h) Vertical Trim Thumbwheel Control. The vertical trim thumbwheel control, placarded **DN** and **UP**, is a three position, return to center rocker switch. Calibration of the control varies, depending on the flight director mode engaged and whether the flight crew activates the vertical trim switch momentarily, allowing it to return to center immediately upon feeling it click (discrete trim), or holds the switch in position for several seconds (continuous trim).

Pressing the upper portion of the rocker switch adjusts the aircraft's pitch attitude downward, and pressing the lower portion adjusts the attitude upward.

Activating vertical trim cancels certain flight director vertical tracking modes, but has no effect on modes engaged in the arm phase. The flight director will revert to pitch attitude hold if it was coupled in glideslope, VNAV, climb, altitude capture, or go-around at the moment of trim activation. If the descent mode was coupled, the flight director will revert to vertical speed hold and will remain coupled throughout vertical trim operation.

If using continuous vertical trim when the capture point is reached, the capture will occur and vertical trim will be ignored until released. After release, further use of vertical trim will cause the same effect as described above. The effect of activating discrete or continuous trim on flight director operations is shown in Table 3A-1.

Table 3A-1. Vertical Trim Command VS Flight Director Operations

TRIM COMMAND	EFFECTS
DISCRETE TRIM	
Pitch Attitude Hold	0.5° per click
Altitude Hold	20 feet per click
Indicated Air Speed Hold	2 knots per click
Vertical Speed Hold	100 fpm per click
CONTINUOUS TRIM	
Pitch Attitude Hold	Maintains constant g profile until release.
Altitude Hold	Maintains 500 fpm climb or descent until release.
Indicated Airspeed Hold	One knot per second until release.
Vertical Speed Hold	100 fpm per second until release.

(i) Pilot/copilot Roll, Pitch, and Yaw Axis Failure Annunciators. Pilot/copilot roll, pitch, and yaw axis failure annunciators, placarded **R**, **P**, and **Y**, indicate autopilot axis decoupling.

System integrity is ensured by automatic self-monitoring tests conducted by the autopilot during autopilot operation. In the event of autopilot or servo motor malfunction, the flight control system automatically disengages the servo motor clutch and drive power to the affected axis. The **R**, **P**, or **Y** indicator lights on the autopilot controller will illuminate to alert the crew of axis decoupling and **AP FAIL** will flash for 2 seconds, then remain illuminated.

(j) Soft Ride Mode Annunciator. Illumination of the soft ride mode annunciator, placarded **SR**, indicates that the soft ride mode has been selected and is engaged.

(k) Soft Ride Mode Push-Button Selector Switch. Pressing the soft ride mode push-button selector switch, placarded **SOFT RIDE**, engages the soft ride mode. With the soft ride mode engaged, the flight director reacts more slowly than normal to deviations from the planned flight track or aircraft attitude. Although soft ride is most useful to reduce command activity in turbulent air, it may be engaged any time a generally smoother flight is more desirable.

Soft ride may be engaged with any mode as long as the autopilot is engaged, with the exception of approach. Soft ride may be employed at the same time as approach arm, but will cancel automatically upon initiation of the approach capture sequence.

(l) Yaw Damper Engage/Disengage Push-Button Selector Switch. The yaw damper engage/ disengage push-button selector switch, placarded **YD**, alternately engages and disengages yaw damper function independently of autopilot or flight director operation. If the yaw damper was previously engaged through autopilot activation, pressing the key cancels the function. The yaw damper augments aircraft stability by opposing uncommanded motion about the yaw axis and provides turn coordination.

(m) Yaw Damper Engaged Annunciator. Illumination of the yaw damper mode annunciator, placarded **YD**, indicates that the yaw damper mode has been selected and is engaged.

g. Autopilot Monitors (KAM 432). The autopilot monitors monitor aircraft movements during autopilot operations. Aircraft accelerations and pitch and roll attitudes and rates are monitored to detect values exceeding the maximum allowable limits. The autopilot monitors also receive signals from primary and trim servos that enable it to detect trim system malfunctions. If the autopilot is shut down by the autopilot monitor, the system cannot be re-engaged without first successfully completing the flight control system's automatic pre-flight test routine. The test may be initiated by cycling power to the flight computer with the autopilot power switch or circuit breaker.

h. Gyro Adapters (KDA 430). The gyro adapters convert information from the aircraft's vertical, directional, and rate gyros and internal accelerometers to digital format for use by the digital flight control system.

i. Vertical Gyros (KVG 350). Roll and pitch attitude information from the vertical gyros provides line of sight stabilization to the weather radar antenna and vertical reference to the autopilot and EFIS.

j. Directional Gyros (KCS 305). The directional gyros provide heading information to the gyro adapter that provides digital heading information to the autopilot/flight director computer and to the air data computer.

k. Rate Turn Gyros (KCS 305). The rate turn gyros provide turn rate information to the gyro adapter that provides digital turn rate information to the autopilot/flight director computer and to the air data computer.

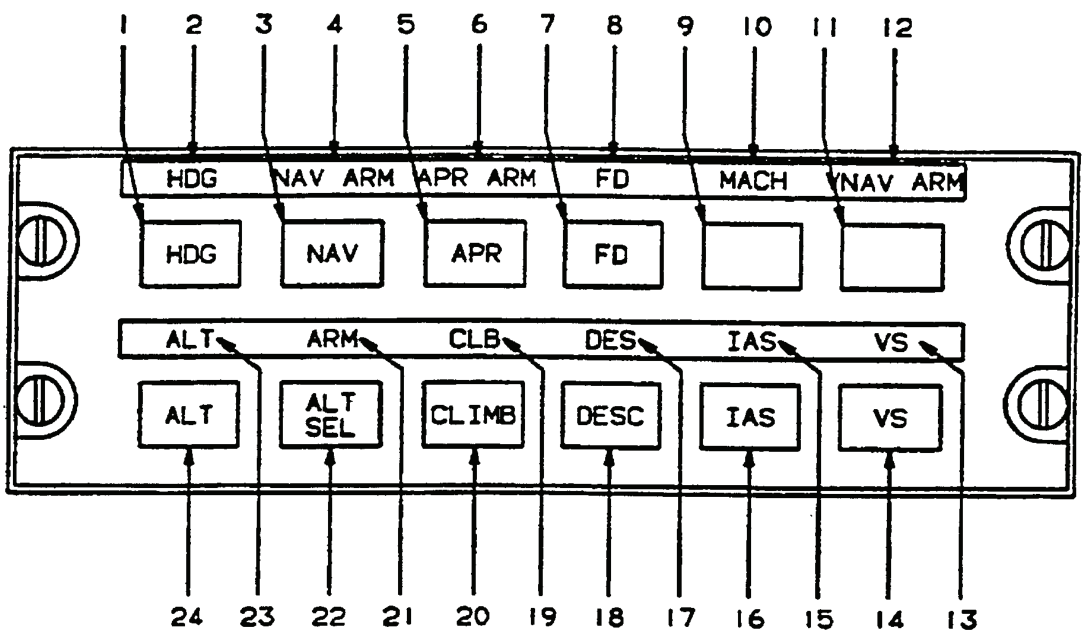
l. Flight Director Mode Selector (KMS 446). The flight director mode selector provides for selection of flight director/autopilot mode of operation.

(1) Flight Director Mode Selector Controls, Indicators, And Functions. Refer to Figure 3A-9.

(a) Heading Mode Push-Button Selector Switch. Pressing the heading mode push-button selector switch, placarded **HDG**, selects the flight director heading mode. In the heading mode the flight director commands roll attitudes necessary to track the heading indicated by the heading marker position on the EHSI and EADI.

Activating the heading mode cancels any other horizontal tracking mode. The heading mode may be used during nav arm or approach arm sequences, but disengages automatically in favor of nav or approach capture or track functions.

(b) Heading Mode Annunciator. Illumination of the heading mode annunciator, placarded **HDG,** indicates that the heading hold mode has been selected and is engaged.



1. **Heading Mode Push-Button Selector Switch**
2. **Heading Mode Annunciator**
3. **Navigation Mode Push-Button Selector Switch**
4. **Navigation Mode Arm Annunciator**
5. **Approach Mode Push-Button Selector Switch**
6. **Approach Mode Arm Annunciator**
7. **Flight Director Mode Push-button Selector Switch**
8. **Flight Director Mode Annunciator**
9. **Not Used**
10. **Not Used**
11. **Not Used**
12. **Not Used**
13. **Vertical Speed Hold Mode Annunciator**
14. **Vertical Speed Hold Push-Button Selector Switch**
15. **Indicated Airspeed Hold Mode Annunciator**
16. **Indicated Airspeed Hold Mode Push-Button Selector Switch**
17. **Descent Mode Annunciator**
18. **Descent Mode Push-Button Selector Switch**
19. **Climb Mode Annunciator**
20. **Climb Mode Push-Button Selector Switch**
21. **Altitude Select Arm Annunciator**
22. **Altitude Select Mode Push-Button Selector Switch**
23. **Altitude Hold Mode Annunciator**
24. **Altitude Hold Mode Push-Button Selector Switch**

Figure 3A-9. Flight Director Mode Selector

(c) Navigation Mode Push-Button Selector Switch. Pressing the navigation mode push-button selector switch, placarded **NAV**, selects the navigation mode. When the **NAV** mode is engaged, the flight director commands roll attitudes necessary to track the course selected on the EHSI. Upon selection, the **NAV** mode engages either NAV ARM or NAV capture, depending upon the aircraft's proximity to the selected course and its closure rate. While any horizontal tracking mode may be engaged in conjunction with NAV ARM to provide intercept guidance, initiation of NAV capture and track sequences cancels the coexisting mode. If the aircraft's deviation from the selected course centerline is sufficiently small, or if the rate of closure with the new course is sufficiently high, the flight director initiates the NAV capture sequence immediately.

(d) Navigation Mode Arm Annunciator. The navigation mode arm annunciator, placarded **NAV ARM**, illuminates to indicate that the navigation mode has been selected and is armed.

(e) Approach Mode Push-Button Selector Switch. Pressing the approach mode push-button selector switch, placarded **APR,** selects the approach flight director mode. The approach mode is similar to the navigation mode with regard to arm, capture, and track operations.

Upon initial selection the approach mode engages in either the approach arm or capture mode, depending upon the aircraft's closure rate and proximity to the selected course. Due to the heightened sensitivity of the deviation display in the approach mode, the flight director may initiate turn commands before the course deviation indicator displays less than a full scale deflection. Selecting the approach mode after the aircraft has already passed the point at which approach capture normally would begin may result initially in course overshoot due to the flight director's roll command limits.

The autopilot automatically discriminates between front and back course approaches. Front course/back course selections are determined by the relative angle between the aircraft's heading and the course selected on the EHSI. Intercept angles of between 0 and 105° will cause the flight control system to select the ILS front course. Angles of between 106 and 180° will cause the flight director to command back course interception and tracking.

NOTE

It is essential that the course selection arrow on the EHSI always be aligned with the ILS front course. Failure to align the course arrow properly may result in erroneous front course/back course selection by the flight control system.

The flight director automatically engages the glideslope arm, capture, and track sequences during ILS front course approaches. Glideslope coupling is inhibited during back course procedures.

Any horizontal tracking mode may be employed during approach arm phases, but will cancel automatically upon initiation of approach capture and track.

(f) Approach Mode Arm Annunciator. Illumination of the approach arm mode annunciator, placarded **APR ARM**, indicates that the approach mode has been selected and is armed.

(g) Flight Director Mode Push-Button Selector Switch. Pressing the flight director mode push-button selector switch, placarded **FD**, initiates flight director functions independently of the autopilot or yaw damper. The flight director will engage roll attitude hold and pitch attitude hold and the command bar will come into view synchronized to the current aircraft attitude. Roll attitudes of less than 2° will revert to wings level flight.

NOTE

It is not necessary to press the flight director key prior to selecting another flight director mode. Selecting any flight director mode initiates flight director commands in that mode.

Pressing the flight director key a second time will disengage the flight director.

NOTE

The flight director will not disengage if the autopilot is in use.

(h) Flight Director Mode Annunciator. Illumination of the flight director mode annunciator, placarded **FD**, indicates that the flight director mode has been selected and is engaged.

(i) Not used.

(j) Not used.

(k) Not Used.

(l) Not Used.

(m) Vertical Speed Hold Mode Annunciator. Illumination of the vertical speed hold mode, placarded **VS**, indicates that the vertical speed hold mode has been selected and is engaged.

(n) Vertical Speed Hold Mode Push-Button Selector Switch. Pressing the vertical speed hold mode push-button selector switch, placarded **VS**, selects the vertical speed hold mode. In the vertical speed mode, the flight director commands pitch attitudes to maintain the vertical speed selected on the altitude/vertical speed indicator. In the absence of a pre-selected vertical speed, engaging the mode will cause the flight director to command a climb or descent at the rate current upon selection. In addition, vertical speed commands may be modified through the use of the autopilot vertical trim at the rate of 100 feet per minute per click during momentary trim operation or 100 feet per minute per second during continuous trim operation.

When vertical speed mode is engaged or the pre-select function of altitude/vertical speed indicator is activated, an orange marker appears on the vertical speed scale. Using the vertical trim switch or the **VS** select knob on the altitude/vertical speed indicator repositions the marker for reference for the pilot and autopilot.

(o) Indicated Airspeed Hold Mode Annunciator. Illumination of the indicated airspeed hold mode annunciator, placarded **IAS**, indicates that the indicated airspeed hold mode has been selected and is engaged.

(p) Indicated Airspeed Hold Mode Push-Button Selector Switch. Pressing the indicated airspeed hold mode push-button selector switch, placarded **IAS**, will cause the flight director to command pitch attitudes to maintain the indicated airspeed current upon selection. Airspeed commands may be altered through the use of the autopilot vertical trim rocker switch at the rate of two knots per click or one knot per second.

As a safety feature, the flight director automatically reverts to indicated airspeed hold whenever the aircraft exceeds a predetermined maximum speed. The flight director will command pitch attitudes to reduce indicated airspeed to V_{moa} and then maintain that airspeed.

(q) Descent Mode Annunciator. Illumination of the descent mode annunciator, placarded **DESC**, indicates that the descent mode has been selected and is engaged.

(r) Descent Mode Push-Button Selector Switch. Pressing the descent mode push-button selector switch, placarded **DESC**, selects the descent mode. In the descent mode the flight director commands pitch attitudes to initiate a descent at a predetermined rate of descent. Engaging the descent mode also arms the altitude capture sequence if the selected altitude is lower than the aircraft's present altitude.

(s) Climb Mode Annunciator. Illumination of the climb mode annunciator, placarded **CLB**, indicates that the climb mode has been selected and is engaged.

(t) Climb Mode Push-Button Selector Switch. Pressing the climb mode push-button selector switch, placarded **CLIMB**, selects flight director climb mode. At typical aircraft climb power settings, selecting the climb mode causes the flight director to command pitch attitudes to maintain a programmed climb that alters airspeed with reference to altitude. The climb profile conforms to a comfortable aircraft attitude for use during en route climbs. The exact climb profile is programmed for this aircraft type.

Engaging the climb mode also activates the altitude select mode whenever a higher altitude is displayed in the altitude/vertical speed indicator's altitude pre-select window. In that case, the flight director automatically cancels the climb mode upon initiation of altitude capture and transition to altitude hold.

Selecting the climb mode with the aircraft operating at a reduced power setting may cause the flight director to command level flight until the aircraft accelerates to the scheduled airspeed for the current altitude. Only upon reaching that target airspeed will the flight director command pitch attitudes to initiate the climb.

(u) Altitude Select Arm Annunciator. Illumination of the altitude select arm mode annunciator, placarded **ARM**, indicates that the altitude select mode has been selected and is armed.

(v) Altitude Select Mode Push-Button Selector Switch. Pressing the altitude select mode push-button selector switch, placarded **ALT SEL**, selects the flight director altitude select mode. The altitude select mode arms the flight director for capture and tracking of altitudes selected with the altitude/vertical speed indicator or the flight management system. A separate vertical mode must be engaged to provide flight guidance to the point of altitude capture. Upon reaching the altitude capture point, the selected vertical mode will cancel and the

flight director will engage altitude capture and then altitude hold.

During transitions to armed altitudes the flight control system will briefly sound an alert tone when the aircraft passes within 1000 feet of the selected altitude. In addition, an alert annunciator illuminates on the altitude/vertical speed indicator when the aircraft is between 1000 and 300 feet above or below the armed altitude. The annunciator will illuminate again briefly when the aircraft reaches the selected altitude. Subsequent alerts are provided if the aircraft deviates 300 feet or more from the selected altitude.

Altitude select will engage automatically with selection of climb or descent modes, provided that a higher or lower altitude is displayed in the altitude pre-select window on the altitude and vertical speed indicator.

(w) Altitude Hold Mode Annunciator. Illumination of the altitude hold mode annunciator, placarded **ALT**, indicates that the altitude hold mode has been selected and is engaged.

(x) Altitude Hold Mode Push-Button Selector Switch. Pressing the altitude hold push-button selector switch, placarded **ALT**, selects the flight director altitude hold mode.

In the altitude hold mode the flight director commands pitch attitudes for capture and tracking of the barometrically corrected aircraft altitude current at the moment of mode selection. Altitude hold can be entered directly or in conjunction with the altitude select mode. Engaging altitude hold directly during a climb or descent will allow the aircraft to fly through the desired altitude and then recover from the other side. For this reason, altitude is most useful for engagement when vertical speed is less than 500 feet per minute.

Selecting altitude hold after the altitude select mode has been engaged cancels altitude select and causes the **ARM** annunciator to extinguish. The flight director will command the aircraft to hold the altitude present at the moment of mode selection.

Altitude hold commands may be modified by holding the autopilot vertical trim rocker switch in the up or down position either momentarily or for several seconds at a time. Momentary switch activation modifies target altitudes at the rate of 20 feet per click. Continuous vertical trim operation causes the flight director to command a climb or descent, as appropriate, at 500 feet per minute until the switch is released.

m. Autopilot Operation.

(1) Autopilot Self Test.

1. **AVIONICS MASTER PWR** – **ON**.

2. **EFIS POWER** switches – **ON**.

3. **AP / TRIM POWER** switch – **ON**.

4. Allow 3-4 minutes for gyros to erect HDG and ATTITUDE flags clear.

5. **AP FAIL** and **AP TRIM FAIL** – Annunciators illuminate upon initial application of **AP/TRIM POWER** and then extinguish (followed by an audio test tone) after successful completion of the self-test. Allow 60 seconds after gyros are valid.

CAUTION

Taxi with caution. The autopilot temporarily engages the servos during the automatic self-test. Be prepared to overpower the autopilot as required.

NOTE

Illumination of the AP FAIL annunciator other than during initial power-up indicates a failure. This failure annunciation will result in power being removed from the roll, pitch, yaw, pitch trim, and rudder trim servos. The flight director may remain functional depending upon the nature of the failure. The continual self-test feature may also inhibit flight director, autopilot and electric trim use without illumination of the AP FAIL annunciator.

(2) Flight Control/Autopilot System Preflight Check.

1. **AP XFER** switch – Select pilot's side.

2. **AP** mode selector button (**AP**) – Press to engage autopilot.

3. Press red **INTRP & TRIM AP DISC** button – Ensure AP disconnects.

If the crew determines a more extensive test is desired, engage AP and continue with steps 4 through 9.

4. Flight controls – Overpower autopilot in pitch, roll, and yaw axis.

WARNING

If unable to overpower the autopilot in any axis, do not use.

5. Auto trim – Check.

   a. Apply nose up force on control wheel – Note nose down trim motion after approximately 3 seconds.

   b. Apply nose down force on control wheel – Note nose up trim motion after approximately 3 seconds.

   c. Press right rudder – Note left rudder trim motion after approximately 3 seconds.

   d. Press left rudder – Note right rudder trim motion after approximately 3 seconds.

6. Select HDG mode – Observe FD commands and control wheel motion correspond to movement of the heading selector knob.

7. **AP DISC** & **TRIM INTRPT** – Press and release. Note autopilot disconnection, flashing **AP** annunciation, and aural disconnect tone.

8. Manual electric trim – Check.

   a. Pilot and copilot control wheel trim switches – Check.

WARNING

Operation of the electric trim switch system should occur only by movement of pairs of switches. Any movement of the elevator trim wheel while pressing only one switch element denotes a trim system malfunction. The AP / TRIM POWER switch must be turned OFF and flight conducted only by manual operation of the trim wheel. Do not use autopilot

   b. Pilot and copilot trim switches – Check individual element for no movement of trim, then check proper operation of both elements.

   c. Pilot trim switches – Check pilot switches override copilot switches while trimming in opposite directions, and trim moves in direction commanded by pilot.

   d. Pilot and copilot trim switches – Check trim disconnects while activating pilot or copilot trim disconnect switches.

9. **AP XFER** Switch – Select copilot's side and repeat steps 2 through 7.

3A-15. ATTITUDE AND HEADING REFERENCE SYSTEM.

The attitude and heading reference system consists of the vertical gyros, directional gyros, dual remote compensator, and flux valves.

The vertical gyros provide the digital flight control system, electronic flight instrument system, and weather radar antenna with pitch and roll information.

The directional gyros, with the flux valve and compensator, provide stabilized magnetic north referenced heading information for use by the digital flight control computer and electronic flight instrument system.

3A-16. AIR DATA SYSTEM.

The digital air data computers are microprocessor-based digital computers that accept both analog and digital inputs, perform digital computations, and supply both digital and analog outputs. They receive both pitot and static pressure for computing standard air data functions. They control autopilot gains as a function of altitude and airspeed. They contain sensors for the flight director modes, altitude hold, vertical speed/indicated airspeed/altitude pre-select, and true airspeed for the flight management system. They also include the sensor function for the altitude portion of the altitude and vertical speed indicator. The altitude encoder for the mode C function of the transponder is also in the air data computer.

3A-17. ELECTRONIC FLIGHT INSTRUMENT SYSTEM.

a. Description. The electronic flight instrument system consists of the pilot's and copilot's EADI and EHSI display units, symbol generators, and EFIS control panel.

The EFIS electronic displays present pitch and roll attitude, heading, course orientation, flight path commands, radio altitude, weather radar and lightning sensor system presentations, and mode and source annunciations. The displays are color coded as shown in Table 3A-2 for easier interpretation of information.

Table 3A-2. EFIS Display Color Codes

COLOR	TYPE OF INFORMATION
Red	Warnings
Yellow	Cautions or abnormal source;
	Cross-side navigation data;
	Cross-side commanded data;
	Cross-side selected active route/ flight plan
Green	On-side approach and navigation data;
	On-side commanded data;
	Selected active route/flight plan
White	Scales and associated figures;
	Held DME distance display
Cyan	On-side non-approach navigation data (LNAV)
Orange	Selected heading/DME HOLD annunciation
Matches NAV data color	Selected source

b. Electronic Flight Instrument System Preflight Test.

NOTE

Performing the EFIS self test is not required at any time. If a failure exists, the small red SG in a red box is displayed. The self-test is intended to familiarize the pilot with the display flags, and for checking proper display color.

1. **BRT** control – Set desired brightness.

2. **TST / REF** push-button switch – Press for 3 seconds. A SELF TEST PASS or SELF TEST FAIL message will be annunciated.

NOTE

White on the compass scale indicates that all three colors are operational in the display unit.

3A-18. EFIS STANDBY POWER SYSTEM.

The EFIS standby power system provides standby electrical power for EFIS system operation when aircraft electrical power is unavailable. The EFIS standby power system control panel is located on the instrument panel. A push-button switch on the control panel, placarded **TEST,** initiates self test. A switch indicator, placarded **ARM TEST** on the top half and **ARM** on the bottom half, is used to select or deselect the armed condition of the system, indicates if self test is in progress, and indicates whether or not the system is armed or not. The standby EFIS power system is protected by a 15-ampere circuit breaker, placarded **EFIS AUX BAT**, located on the right sidewall circuit breaker panel, Figure 2-6.

3A-19. EFIS CONTROL PANEL.

a. Description. The EFIS control panel enables each pilot to control formatting on his respective EHSI and EADI and to select the source of navigation, attitude, and heading information. Refer to Figure 3A-10.

b. EFIS Control Panel Controls, Indicators, and Functions.

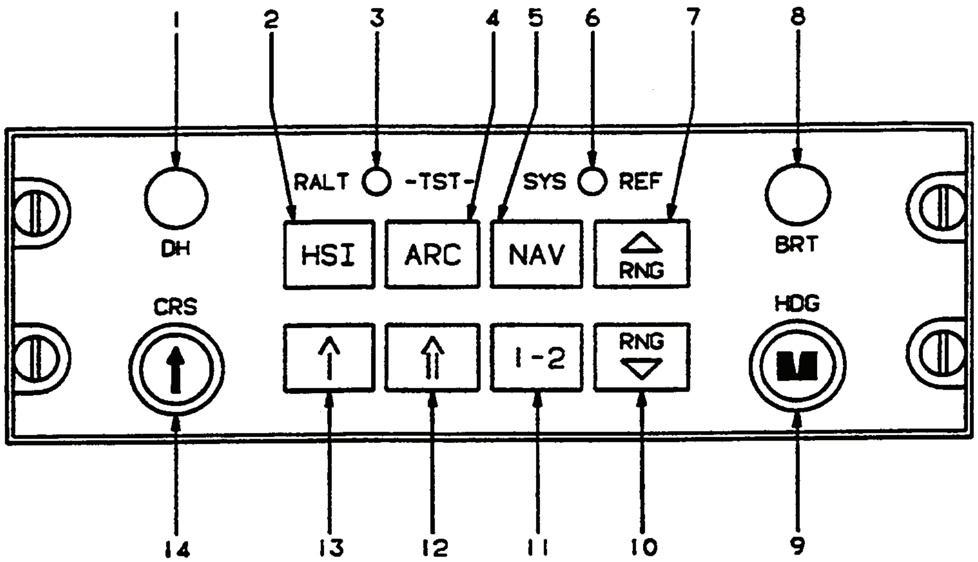
(1) Radio Altimeter Decision Height Set Knob. The radio altimeter decision height set knob, placarded **DH**, is used to set the desired decision height in feet that is shown in the green **DH** display located in the lower left comer of each EADI. To set the decision height, pull out the knob and then turn it clockwise to increase the selected decision height or counterclockwise to decrease the selected decision height. The decision height set knob is variable rate; that is, turning the knob farther in either direction will increase the rate of change in selected decision height. The decision height selection range is from **OFF** (-1 foot) to 2500 feet.

Push the **DH** knob back in after the decision height has been set to lock the selected **DH** altitude. If the **DH** is set to **OFF** the **DH** annunciator will not be displayed on the EADI.

(2) HSI 360 Degree Push-Button Selector Switch. The HSI 360° push-button selector switch, placarded **HSI**, is used to select one of four possible 360° formats for the HSI. Each press of the **HSI** switch sequences to the next display format. The four possible 360° HSI formats are Standard HSI compass rose; Navigation map; Navigation map with weather radar display, and Directional gyro mode.

(3) Radio Altimeter Push-Button Test Switch. Pressing the radio altimeter test switch, placarded

RALT TST, provides a discrete output to the radio altimeter initiating its self-test function.



1. **Radio Altimeter Decision Height Set Knob**
2. **HSI 360 Degree Push-Button Selector Switch**
3. **Radio Altimeter Push-Button Test Switch**
4. **HSI ARC Push-Button Selector Switch**
5. **Navigation Source Push-Button Selector Switch**
6. **System/Reference Push-Button Test Switch**
7. **Range Up Switch**
8. **Brightness Control**
9. **Heading Select Knob**
10. **Range Down Switch**
11. **Primary Navigation Sensor System Push-Button Selector Switch**
12. **HSI Double Needle Bearing Pointer Source Push-Button Selector Switch**
13. **HSI Single Needle Bearing Pointer Source Push-Button Selector Switch**
14. **HSI Course Select Knob**

Figure 3A-10. EFIS Control Panel

(4) HSI Arc Push-Button Selector Switch. The arc push-button selector switch, placarded **ARC**, is used to select one of five possible 85° arc formats for the HSI. Each press of the **HSI** switch sequences to the next display format. The four possible arc formats are: Arc compass rose; Arc navigation map; Arc navigation map with weather radar display; and Arc compass rose with weather radar display.

(5) Navigation Source Push-Button Selector Switch. Pressing the navigation source push-button selector switch, placarded **NAV**, sequentially selects the next navigation sensor from the list of those installed. An annunciator on the EADI displays the selected sensor. Possible primary navigation sources are: VOR, LOC, TCN, FMS, GPS, and ADF.

(6) System/Reference Push-Button Test Switch. The system/reference push-button test switch, placarded **SYS REF**, initiates EFIS system self test.

(7) Range Up Switch. Pressing the range up switch, placarded **RNG**, will select the next higher range to be displayed on the EHSI while in the NAV MAP or WEATHER modes. Once the highest selectable range has been reached, the range down switch must be used to change range.

(8) Brightness Control. The display brightness control, placarded **BRT**, provides full range dimming for night operation in no or low light situations.

NOTE

The lower limit of display brightness may appear as an inoperative tube during normal daylight operation.

(9) Heading Select Knob. Rotation of the heading select knob, placarded **HDG**, allows positioning the heading marker on the EHSI and EADI at the desired heading. Pulling out on the heading select knob will cause the heading marker on the EHSI

and EADI to move to the present aircraft beading (lubber line).

(10) Range Down Switch. Pressing the range down switch, placarded **RNG**, will select the next lower range to be displayed on the EHSI while in the NAV MAP or WEATHER modes. Once the lowest selectable range is reached, the range up switch must be used to change range.

(11) Primary Navigation Sensor System Push-Button Selector Switch. The primary navigation sensor system push-button selector switch, placarded **1 – 2**, is used to select either primary navigation sensor system #1 or #2 for display on the EFIS system. The primary NAV system selected is annunciated as sensor 1 or 2 on the EHSI. For example, if VOR 1 is being displayed and the **1 – 2** switch is pressed, VOR 2 will become the displayed sensor. If only one sensor is installed, the display will not cycle and the sensor annunciation will not show a system number. For example, ADF is displayed (not ADF 1), since only one ADF is installed.

(12) HSI Double Needle Bearing Pointer Source Push-Button Selector Switch. Pressing the **HSI** double needle bearing pointer source selector switch selects the next available sensor for display. The bearing pointer sensor list contains only those sensors that have bearing information capabilities. If the selected sensor has distance information paired with it, that distance will also be displayed below the sensor annunciation. Possible sensors for the double needle bearing pointer are as follows.

1. DECLUTTER (no number one or number two bearing pointer information is displayed).
2. VOR.
3. TCN.
4. LNAV (GPS).
5. ADF.
6. DME number one (distance only).

(13) HSI Single Needle Bearing Pointer Source Push-Button Selector Switch. Pressing the **HSI** single needle bearing pointer source selector switch selects the next available sensor for display. The bearing pointer sensor list contains only those sensors that have bearing information capabilities. If the selected sensor has distance information paired with it, that distance will also be displayed below the sensor annunciation. Possible sensors for the single needle bearing pointer are the same as for the double needle bearing pointer.

(14) HSI Course Select Knob. Rotation of the course select knob, placarded **CRS**, allows the course pointer and digital course to be set to the desired course. Pulling the course select knob out will cause the course pointer and digital course readout on the EHSI to change to the direct course to the selected navaid or active waypoint.

3A-20. ELECTRONIC ATTITUDE DIRECTOR INDICATOR (EADI).

a. Description. The EADI combines a sphere-type attitude display with lateral and vertical computed steering signals to provide commands required to intercept and maintain a desired flight path. Refer to Figure 3A-11 for EADI Fault Annunciators and 3A-12 for EADI Category II Symbology. The EADI provides the following display information.

1. Attitude display.
2. Flight director command cue.
3. Flight director mode annunciations.
4. Heading.
5. Vertical deviation.
6. Expanded localizer.
7. Radio altitude with rising runway display.
8. Decision height setting and annunciations.
9. Marker beacon annunciations.
10. Air data command.
11. Rate of turn.
12. Reversionary annunciations.
13. Flags.
14. Comparison monitors.

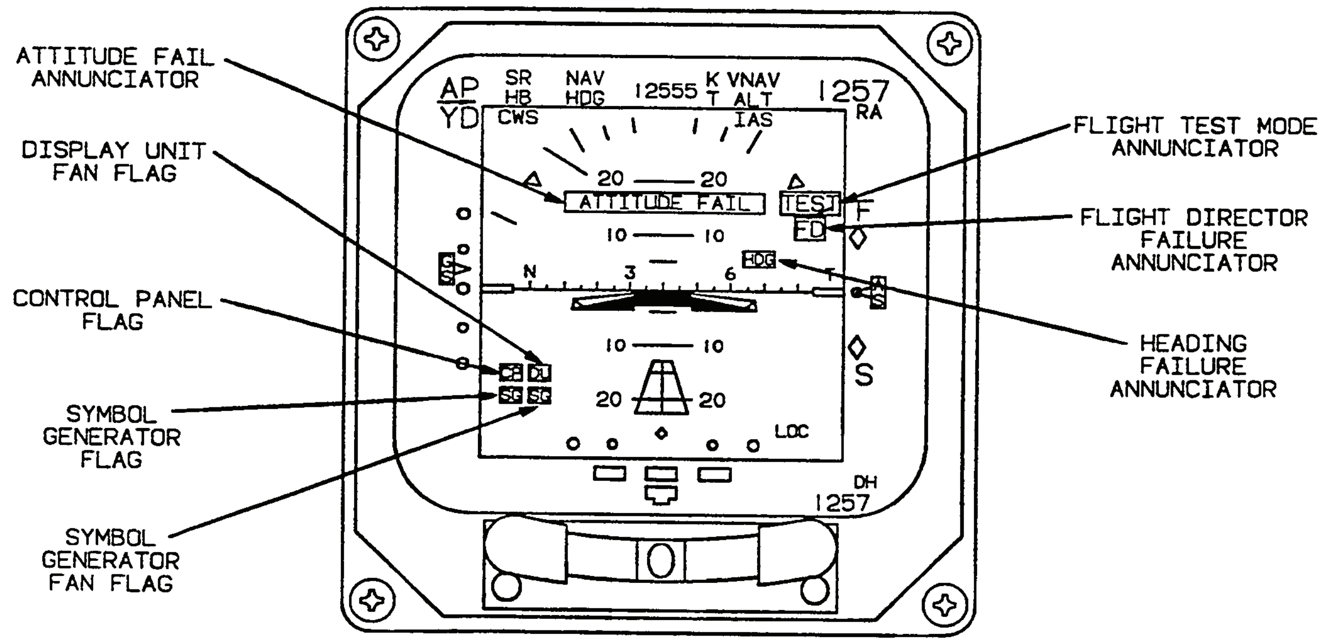


Figure 3A-11. EADI Fault Annunciators

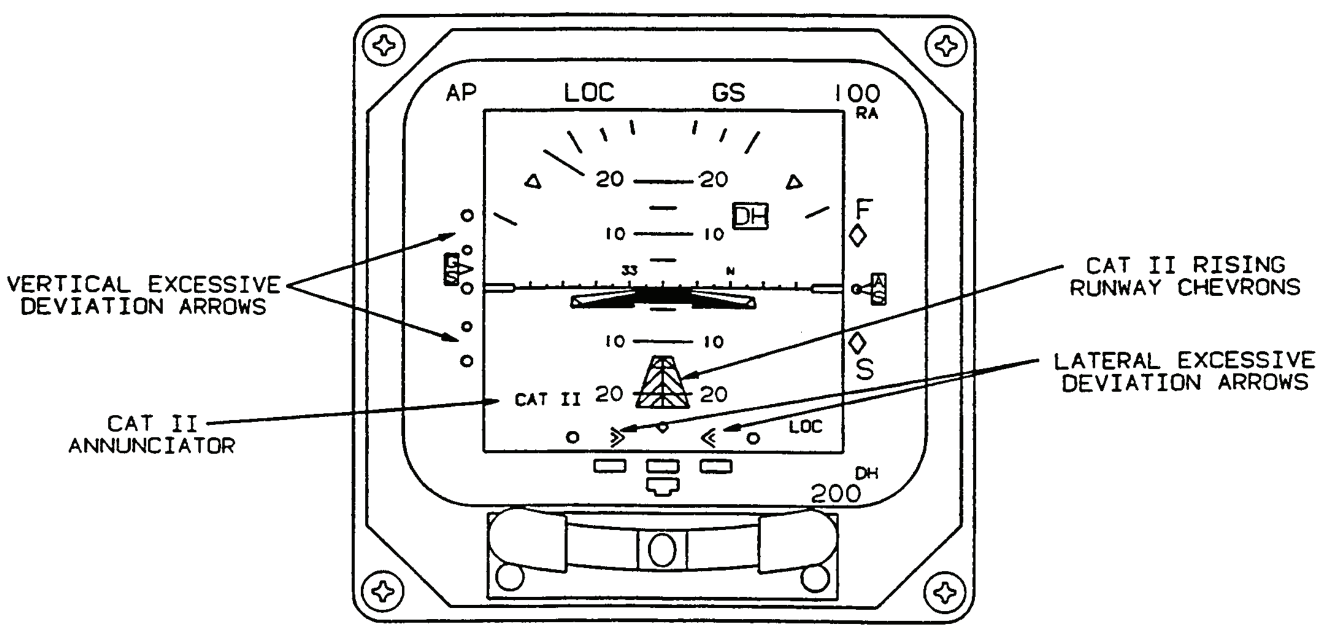


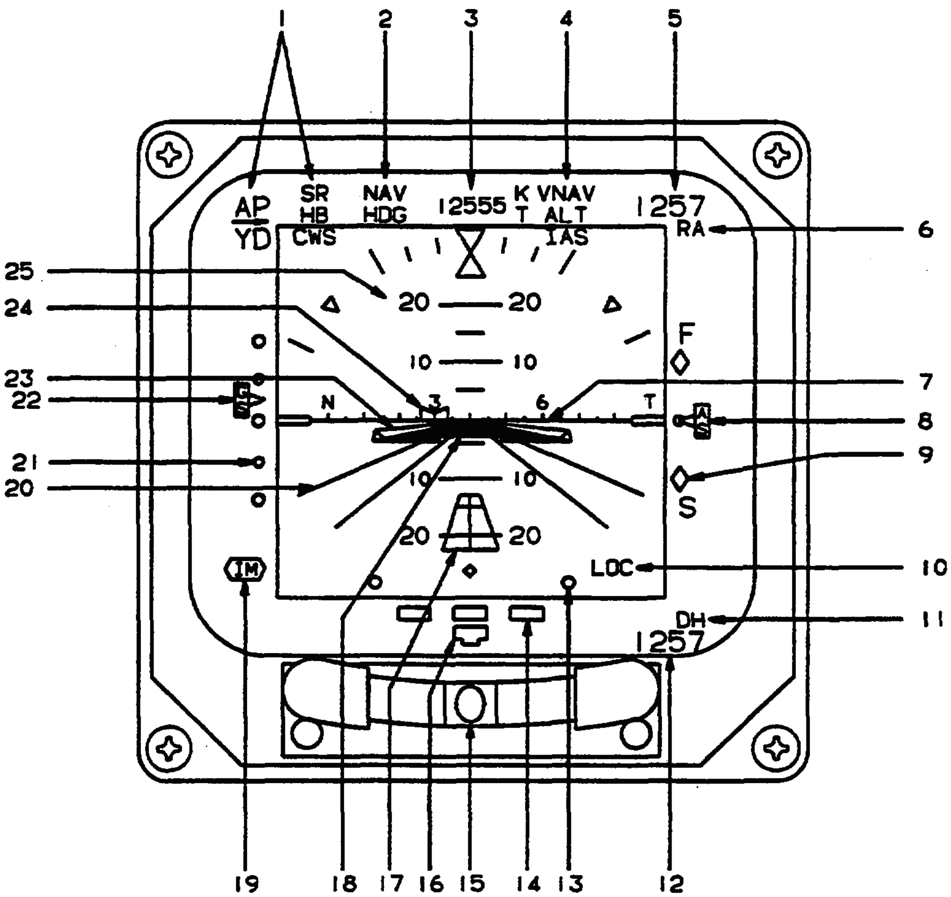
Figure 3A-12. EADI Category II Symbology

b. EADI Controls, Indicators, and Functions. Refer to Figure 3A-13.

(1) Autopilot/Yaw Damper Mode Annunciators. The autopilot/yaw damper mode annunciators are located in the upper left comer of the EADI.

(a) AP Mode Annunciator. The **AP** mode annunciator illuminates green to indicate that the autopilot is engaged. If the autopilot has been engaged and then disengaged, a flashing red **AP** will be annunciated. A yellow horizontal arrow under the AP annunciator will be displayed on the inactive side (side not controlling the aircraft), pointing toward the active side.

*(b) **YD** Mode Annunciator.* The **YD** mode annunciator illuminates green to indicate that the yaw damper is engaged.



1. Autopilot/Yaw Damper Mode Annunciators
2. Autopilot/Flight Director Lateral Mode Annunciators
3. Autopilot Command Data Display
4. Autopilot/Flight Director Vertical Mode Annunciators Runway Indicator
5. Radio Altimeter Digital Altitude Display (For Single-Cue Command Bars)
6. Radio Altimeter Annunciator
7. Horizon Line With Heading Scale
8. Airspeed Fast/Slow or Angle of Attack Indicator
9. Airspeed Fast/Slow or Angle of Attack Scale Command Bars
10. Lateral Deviation Scale Annunciator
11. Decision Height Annunciator
12. Decision Height Digital Display
13. Lateral Deviation Scale
14. Rate of Turn Scale
15. Inclinometer
16. Rate of Turn Indicator
17. Rising Runway Indicator
18. Delta Aircraft Symbol
19. Marker Beacon Annunciators
20. Perspective Lines
21. Vertical Deviation Scale
22. Vertical Deviation Indicator
23. Single-Cue Flight Director
24. Heading Marker
25. Pitch Attitude Scale

Figure 3A-13. Electronic Attitude Director Indicator *(c)* ***SR*** *Mode Annunciator.* The **SR** mode annunciator illuminates green to indicate that soft ride mode has been selected on the autopilot controller.

(d) ***HB*** *Mode Annunciator.* The **HB** mode annunciator illuminates green to indicate that half bank mode has been selected on the autopilot controller.

(e) ***CWS*** *Mode Annunciator.* The **CWS** mode annunciator illuminates green to indicate that the control wheel steering switch on a control wheel is being held pressed, allowing the aircraft to be maneuvered with the autopilot servos disengaged allowing the pilot to synchronize flight director commands in pitch and roll.

(2) Autopilot/Flight Director Lateral Mode Annunciators. The autopilot/flight director lateral mode annunciators are located on the upper portion of the EADI to the right of the autopilot/yaw damper annunciators.

(a) ***HDG*** *Mode Annunciator.* Illumination of the heading mode annunciator, placarded **HDG**, indicates that the heading mode has been selected and is engaged.

(b) ***NAV*** *(Arm) Mode Annunciator.* Illumination of the white navigation arm mode annunciator, placarded **NAV**, indicates that navigation mode on the flight director mode selector panel has been selected and is in an armed condition.

(c) ***NAV*** *Mode Annunciator.* Illumination of the green navigation mode annunciator, placarded **NAV**, indicates that navigation mode on the flight director mode selector panel has been selected and is engaged.

(d) ***LOC*** *(Arm) Mode Annunciator.* Illumination of the white localizer mode annunciator, placarded **LOC**, indicates that the localizer mode on the flight director mode selector panel has been selected and is in an armed condition.

(e) ***LOC*** *Mode Annunciator.* Illumination of the green localizer mode annunciator, placarded **LOC**, indicates that the localizer mode on the flight director mode selector panel has been selected and is engaged.

(f) ***APR*** *(Arm) Mode Annunciator.* Illumination of the white approach arm mode annunciator, placarded **APR**, indicates that the approach mode on the flight director mode selector panel has been selected and is in an armed condition.

(g) ***APR*** *Mode Annunciator.* Illumination of the green approach mode annunciator, placarded **APR**, indicates that the approach mode on the flight director mode selector panel has been selected and is engaged.

(h) ***BC*** *(Arm) Mode Annunciator.* Illumination of the white back course mode annunciator, placarded **BC**, indicates that approach mode on the flight director mode selector panel has been selected for a back localizer course and is in an armed condition.

(i) ***BC*** *Mode Annunciator.* Illumination of the green back course mode annunciator, placarded **BC**, indicates that approach mode on the flight director mode selector panel has been selected for a back localizer course and is engaged.

(j) ***ROL*** *Mode Annunciator.* Illumination of the green roll attitude hold mode annunciator, placarded **ROL**, indicates that the roll rate command knob on the autopilot controller has been moved from its center detent position, engaging the roll attitude hold mode.

(3) Autopilot Command Data Display. The following autopilot command reference data may be displayed in green on the top center of EADI.

Airspeed.	0 to 512 knots in 1 knot increments
Mach.	1 to 4.096 mach in 0.005 mach increments
Vertical speed.	± 20,480 feet per minute in 100-foot per minute increments
Profile.	**H** – High
	N – Normal
	L – Low

(4) Autopilot/Flight Director Vertical Mode Annunciators. The autopilot/flight director vertical mode annunciators are located on the upper portion of the EADI to the right of the autopilot command data display.

(a) ***ALT*** *Mode Annunciator.* Illumination of the green altitude hold mode annunciator, placarded **ALT**, indicates that the altitude hold mode on the flight director mode selector panel has been selected and is engaged.

(b) ***VS*** *Mode Annunciator.* Illumination of the green vertical speed mode annunciator, placarded **VS**, indicates that the vertical speed mode

on the flight director mode selector panel has been selected and is engaged.

*(c) **IAS** Mode Annunciator.* Illumination of the green indicated airspeed hold mode annunciator, placarded **IAS**, indicates that the indicated airspeed hold mode on the flight director mode selector panel has been selected and is engaged.

*(d) **GS** Mode Annunciator.* Illumination of the green glideslope mode annunciator, placarded **GS**, indicates that the approach mode on the flight director mode selector panel has been selected and has captured the glideslope.

*(e) **GA** Mode Annunciator.* Illumination of the green go-around mode annunciator, placarded **GA**, indicates that the **GO AROUND** switch on the left power lever or the **GA** switch on the copilot's control wheel has been pressed and the go-around mode has been initiated.

*(f) **PIT** Mode Annunciator.* Illumination of the green pitch mode annunciator, placarded **PIT**, indicates that the vertical trim thumbwheel on the autopilot controller is being operated.

*(g) **ALTC** Mode Annunciator.* Illumination of the green altitude hold capture mode annunciator, placarded **ALTC**, indicates that the selected altitude has been captured.

*(h) **VNAV** Mode Annunciator.* Illumination of the green vertical navigation mode annunciator, placarded **VNAV**, indicates that the vertical navigation mode on the flight director mode selector panel has been selected and is engaged.

*(i) **H / L / N CLB** Mode Annunciator.* Illumination of the green high, low, or normal climb profile mode annunciators, placarded **H / L / N CLB**, indicates that the high, low, or normal climb profile mode on the flight director mode selector panel has been selected and is engaged.

*(j) **H / L / N DES** Mode Annunciator.* Illumination of the green high, low, or normal descent profile mode annunciators, placarded **H / L / N DES**, indicates that the high, low, or normal descent profile mode on the flight director mode selector panel has been selected and is engaged.

(5) Radio Altimeter Digital Altitude Display and Annunciator. Radio altitude is displayed in the upper right corner of the EHSI in feet above ground level.

(6) Radio Altimeter Annunciator. Radio altimeter operation is indicated by a white RA below the radio altitude display.

(7) Horizon Line With Heading Scale. The horizon line displays aircraft pitch and roll attitude with respect to the earth's horizon.

(8) Airspeed Fast/Slow Or Angle Of Attack Indicator And Scale. The fast/slow or angle of attack display is located on the opposite side of the EADI from the glideslope display, and consists of two vertical white unfilled diamonds and one white unfilled circle. The fast/slow scale and indicator will be displayed when the airspeed is within 10 knots more or less than the selected hold airspeed. The scale provides a ± 10 knot airspeed indication range.

(9) Airspeed Fast/Slow or Angle of Attack Scale Command Bars. If airspeed is the referenced data, AS will be annunciated on the pointer. If angle of attack is the referenced data, AN will be annunciated on the pointer.

(10) Lateral Deviation Scale Annunciator. The lateral deviation scale annunciator displays LOC to indicate that localizer information is being provided by the lateral deviation indicator and scale.

(11) Decision Height Annunciator. The decision height annunciator, placarded **DH**, illuminates when the selected decision height has been reached.

(12) Decision Height Digital Display. The decision height digital display in the lower right corner of the EADI indicates selected decision height.

(13) Lateral Deviation Scale. The lateral deviation scale, located at the bottom center of the EADI provides a lateral reference for the rising runway symbol when ILS is selected. As an expanded scale, it represents 1/2 full-scale deviation as displayed on the EHSI. When the selected course and aircraft heading differ by more 105°, the left/right sense will be reversed and BC will be displayed to the left of the center diamond to indicate that back course information is being displayed.

(14) Rate Of Turn Scale. The rate and direction of turn is indicated by the rate turn scale and pointer and indicator, located at the bottom of the EADI.

(15) Inclinometer. Deflection of the inclinometer ball from the center of the inclinometer tube indicates that the aircraft is in a slipping or skidding turn depending on turn direction.

(16) Rate of Turn Indicator. The rate of turn indicator is located directly below rate of turn scale and moves to indicate direction and rate of turn.

(17) Rising Runway Indicator. The rising runway will be displayed on the EADI when the flight director is in the precision approach mode. The centerline of the rising runway represents the ILS lateral fly to command. If the radio altimeter is providing height above ground level information, the rising runway will start increasing in size at 200 feet AGL and will continue to increase in size to 0 feet AGL.

(18) Delta Aircraft Symbol. The pitch and roll attitude of the aircraft are displayed by the relationship of the fixed delta aircraft symbol and the movable horizon. The symbolic aircraft is flown to satisfy the command cues of the flight director command bars.

(19) Marker Beacon Annunciators. The marker beacon annunciators in the lower left corner of the EADI illuminate when Outer Marker (OM), Middle Marker (MM), or Inner Marker (IM) signals are received.

(20) Perspective Lines. The perspective lines extend downward from the center of the horizon line to provide additional cues during steep turns.

(21) Vertical Deviation Scale. The vertical deviation scale is located on the right side of the EADI and provides a vertical reference of the aircraft in relation to the Glideslope or climb/descent profiles.

(22) Vertical Deviation Indicator. The vertical deviation indicator and scale display deviation from the glideslope when on an ILS approach or deviation from a vertical climb or descent profile when vertical navigation is in use.

(23) Single-Cue Flight Director Command Bars. The command bars indicate where to move the delta aircraft symbol to satisfy the pitch and roll commands computed by the flight director.

(24) Heading Marker. The heading marker, located on the heading scale on the horizon line, is used to select the heading to be flown.

(25) Pitch Attitude Scale. The aircraft's pitch angle with respect to the earth's horizon may be read at the center of the horizon line.

3A-21. ELECTRONIC HORIZONTAL SITUATION INDICATOR.

a. Description. The Electronic Horizontal Situation Indicator combines several displays to provide a map-like display of aircraft position. The indicator displays aircraft displacement relative to a VOR or TACAN radial and localizer and glideslope beam. The EHSI provides the following full and partial compass display information.

(1) Full Compass Displays. Refer to Figure 3A-14.

1. Heading
2. Course selection
3. Course or azimuth deviation
4. Distance
5. Groundspeed
6. To/from
7. Desired track
8. Bearing
9. Heading selection
10. Glideslope deviation
11. Time-to-go
12. Heading and navigation source annunciators
13. Heading synchronization

(2) Partial Compass Displays. Refer to Figure 3A-15.

1. Weather radar
2. Lightning sensor system data
3. Navigation map

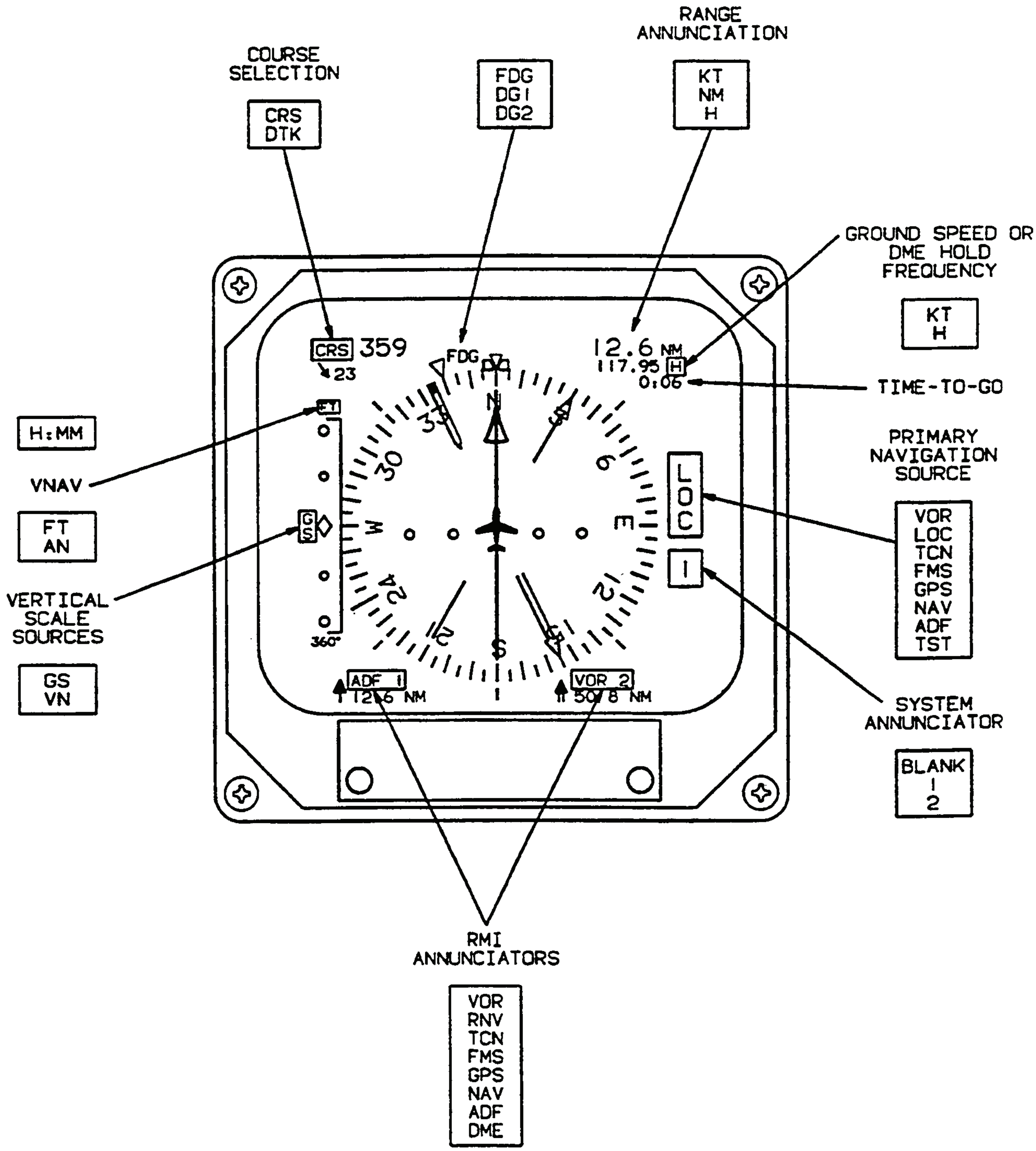


Figure 3A-14. Electronic Horizontal Situation Indicator Symbol Definitions

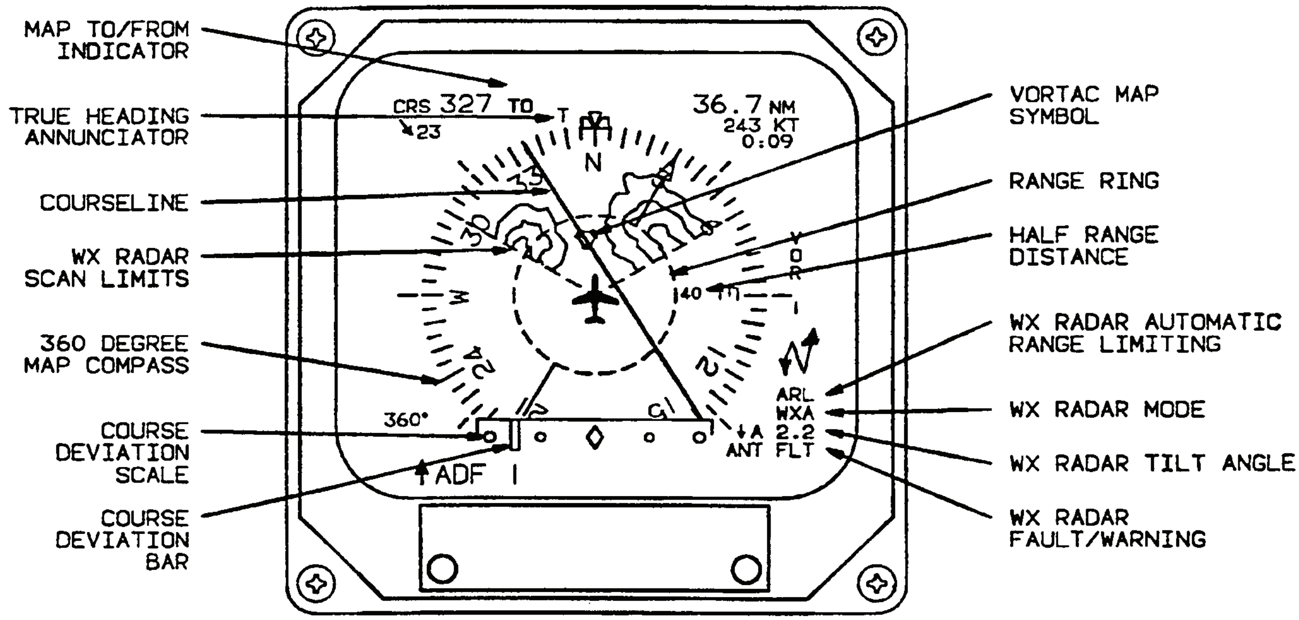


Figure 3A-15. EHSI 360° Map Symbol Definitions

b. EHSI Controls, Indicators, and Functions. Refer to Figure 3A-16.

(1) Course/Desired Track Digital Display. The course/desired track digital display is an alphanumeric display located in the upper left comer of the EHSI. It displays **CRS** followed by the selected navigation course in degrees. The **CRS** knob on the EFIS control panel rotates the course pointer about the compass scale and sets the course/desired track digital display.

(2) Drift Angle Indicator. The drift angle pointer is a triangular pointer that is generated by the GPS and rotates around the outside of the compass scale. Referenced to the lubber line, the drift angle pointer displays drift angle left or right of aircraft heading. With respect to the compass scale, the drift angle pointer displays actual ground track. Drift angle pointer information is provided by the GPS and will be displayed only when the GPS is selected as the primary navigation source and valid information is present. If the pointer information becomes invalid, it will be removed from the display.

(3) Directional Gyro Mode Or Source. The directional gyro mode or source annunciator located to the left of the lubber line indicates whether heading information is being supplied to the EFIS from directional gyro number 1 or 2 (DG1 or DG2), or if the system is operating in the free gyro mode (FDG).

(4) Lubber Line. Aircraft heading is read from the compass card under the lubber line.

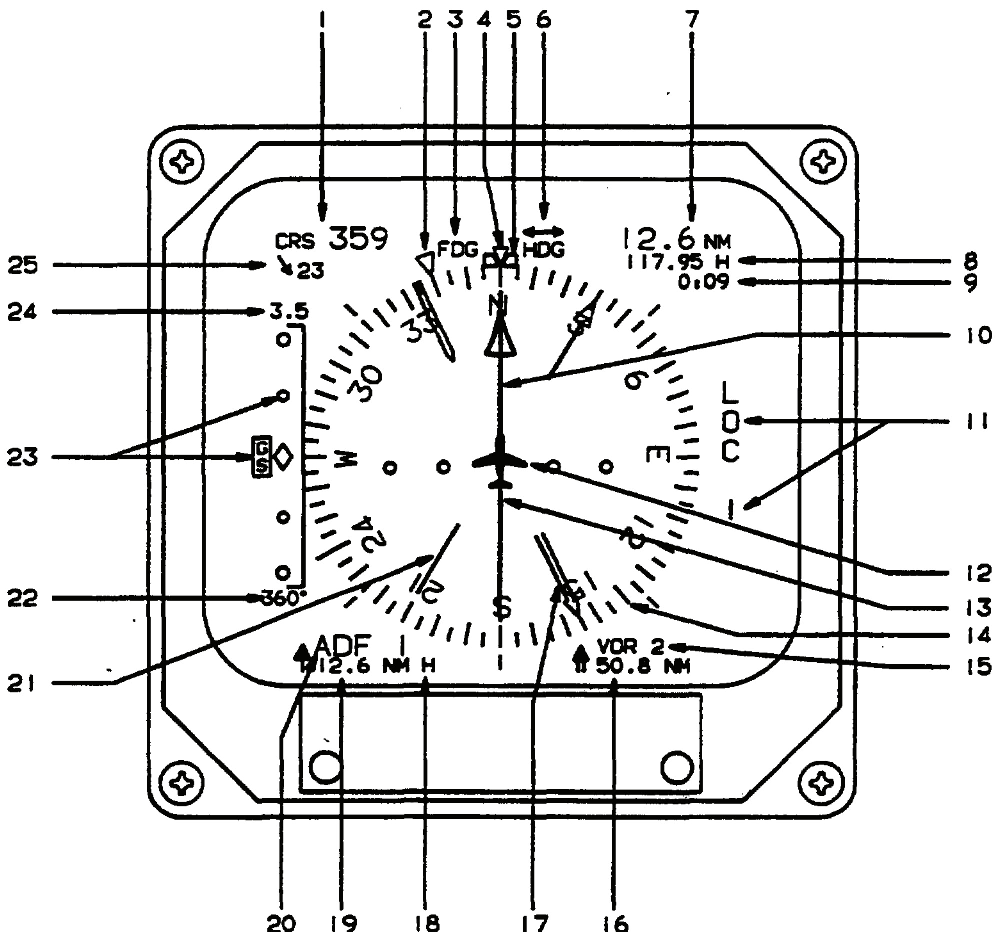
(5) Heading Marker. The heading marker is positioned on the compass card by rotating the heading select knob located on the EFIS control panel.

(6) Heading Miscompare Indicator. The yellow double-ended heading miscompare arrow will be displayed over HDG to the left of the lubber line on the EHSI if heading 1, 2, and cross-side differ by more than 6° up to 6° of bank and by more than 20° above 6° of bank. If bank information is not available the heading miscompare will be displayed if heading differs by more than 20°. The heading miscompare symbol will also be displayed if the failure warning flags differ. Heading miscompare will not be performed if sources are not all magnetic or all true.

(7) Primary Navigation Source Range (Or Held DME Distance). The range display for the primary navigation source or DME hold distance is displayed in the upper right comer of the EHSI.

(8) Groundspeed or DME Hold Frequency. Displays groundspeed to 999 KTS or DME hold frequency.

(9) Time To Go. Displays time to station up to 8:31 (H:MM universal format). Time to station is displayed immediately below and at the same time as groundspeed.



1. Course/Desired Track Digital Display
2. Drift Angle Indicator Source Annunciator
3. Directional Gyro Mode or Source
4. Lubber Line Bearing Pointer Distance
5. Heading Marker
6. Heading Miscompare Indicator
7. Primary Navigation Source Range (or Held DME Distance) Bearing Pointer Distance
8. Groundspeed or DME Hold Frequency
9. Time To Go Source Annunciator
10. Course Pointer
11. Primary Navigation Source and System Number Annunciator
12. Symbolic Aircraft
13. Course Deviation Bar
14. Compass Card
15. Double Bar (#2 System) Bearing Pointer
16. Double Bar (#2 System)
17. Double Bar (#2 System) Bearing Pointer
18. DME Hold Annunciator
19. Single Bar (#1 System)
20. Single Bar (#1 System) Bearing Pointer
21. Single Bar (#1 System) Bearing Pointer
22. Selected Heading Digital Display
23. Vertical Deviation Scale and Indicator
24. VNAV Mode Annunciator
25. Wind Speed and Wind Vector

Figure 3A-16. EHSI Controls and Indicators

(10) Course Pointer. The position of the course pointer on the compass card indicates the course that has been selected with the course select knob on the EFIS control panel. Once set, the course pointer rotates with the compass card.

(11) Primary Navigation Source and System Number Annunciator. The primary navigation source annunciator displays the primary navigation and system number if applicable (such as VOR 1 or VOR 2).

(12) Symbolic Aircraft. The symbolic aircraft provides a quick visual cue as to the aircraft's position with respect to the select course and aircraft heading.

(13) Course Deviation Bar. The course deviation bar represents the centerline of the selected navigation or localizer course.

(14) Compass Card. The compass card indicates aircraft heading referenced to the white triangular heading index (lubber line). The compass scale is divided in 5° increments with the 10° divisions being approximately twice as long. Fixed 45° index marks are adjacent to the compass scale.

(15) Double Bar (#2 System) Bearing Pointer Source Annunciator. The double bar bearing source annunciator displays the navigation sensor providing bearing information to the double bar pointer.

(16) Double Bar (#2 System) Bearing Pointer Distance. The double bar (#2 system) bearing pointer distance display shows the distance to the selected bearing reference ground station.

(17) Double Bar (#2 System) Bearing Pointer. The double bar *(#2* system) bearing pointer points to the selected bearing sensor ground station, or waypoint when in the LNAV mode.

(18) DME Hold Annunciator. The DME hold annunciator is displayed when the DME hold function is selected.

(19) Single Bar (#1 *System) Bearing Pointer Distance.* The single bar (#1 system) bearing pointer distance display shows the distance to the selected bearing reference ground station.

(20) Single Bar (#1 System) Bearing Pointer Source Annunciator. The single bar bearing source annunciator displays the navigation sensor providing bearing information to the single bar pointer.

*(21) Single Bar (#*1 *System) Bearing Pointer.* The single bar (#1 system) bearing pointer points to the selected bearing sensor ground station (or waypoint when in the LNAV mode).

(22) Selected Heading Digital Display. When the EHSI is in the 360° compass mode, a full time digital readout of the heading selected with the heading select knob is shown on a digital display on the left side of the EHSI below the vertical deviation scale as well as by the heading marker.

(23) Vertical Deviation Scale And Indicator. The vertical deviation scale appears on the left side of the EHSI when ILS or VNAV is selected. The white vertical deviation scale provides a reference for the vertical deviation indicator. The scale and indicator provide ILS glideslope and vertical navigation (VNAV) deviation information. The deviation indicator moves in relation to the scale to indicate glide path center with respect to aircraft position.

(24) VNAV Mode Annunciator. Indicates whether VNAV information displayed by the vertical deviation pointer and scale is feet (FT) or angle in degrees (AN).

(25) Wind Speed and Wind Vector. Wind speed and direction information is displayed in the upper left corner of the EHSI if using LNAV (GPS or FMS) as the primary navigation source.

3A-22. ELECTRONIC FLIGHT INSTRUMENT SYSTEM COMPOSITE DISPLAY MODES.

If an EFIS display or EADI symbol generator section fails, the composite mode may be selected for display on the remaining good display unit by pressing the composite, placarded **CMPST**, switch indicator on the instrument panel. The base composite display uses the standard EADI display for its foundation. To it is added a standard lateral deviation scale, selected CRS, selected HDG, distance information, DME HOLD annunciation, selected NAV sensor, and TO / FR information. Creating a composite display in this manner provides the pilot a familiar display, which requires minimal transition time when it is selected for use. The composite en route mode display is shown in Figure 3A-17 and the composite approach mode display is shown in Figure 3A-18.

NOTE

If the EADI section of the symbol generator fails, a full composite display may be displayed on the EHSI. If the EHSI section fails, only pitch and roll information will be displayed on the EADI.

The following paragraphs describe the areas of the composite display that differ from the standard EADI display.

NOTE

As the aircraft heading changes, the selected course arrow will follow the heading tape and may disappear from view.

a. Heading Tape. If the heading data along the top of the horizon line becomes unavailable or invalid, a stationary red HDG annunciator will be displayed above and to the right of the symbolic aircraft.

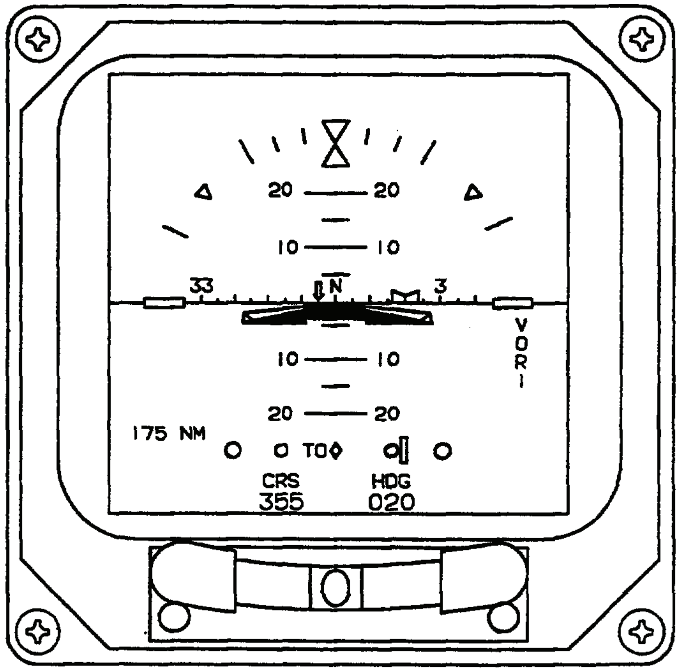
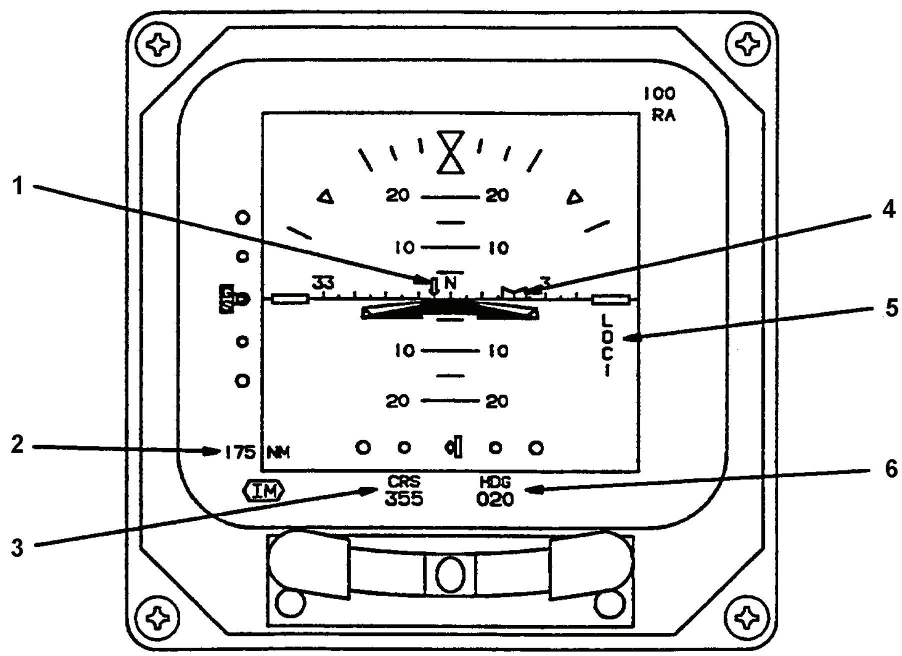


Figure 3A-17. Composite En Route Mode Display



1. Course Pointer
2. DME/LNAV Distance
3. Selected Course
4. Heading Bug
5. Primary Navigation Sensor
6. Selected Heading

Figure 3A-18. Composite Approach Mode Display

b. Selected Course. Selected course is shown by a green alphanumeric display located toward the bottom of the display. In addition to the digital display, a downward pointing arrow on the heading tape shows the selected course.

If the selected primary NAV sensor is an on-side sensor the digital readout and pointer will be displayed in green. If an on-side LNAV is the selected primary NAV sensor and it is in the approach mode, the digital readout and pointer will be green. If the en route mode is selected, the readout and pointer will be cyan. If an off-side sensor is selected, the digital readout and pointer will be yellow.

c. Heading Marker Selected Heading. A digital display of selected heading is displayed toward the bottom of the screen to the right of center. The selected heading is also shown by the orange heading marker on the heading tape.

NOTE

As the aircraft heading changes, the heading marker will follow the heading tape and may disappear from view.

d. Navigation Source Annunciation. The primary navigation sensor is displayed on the left side of the display. A green annunciation indicates an on-side approach NAV system is being displayed. A yellow annunciation indicates that a cross-side system has been selected. Cyan annunciations apply to on-side non-approach NAV systems. These color codes apply to the NAV source annunciator CRS pointer, course deviation bar, CRS, and distance. If both sides select the same navigation source a yellow box will be placed around the navigation source annunciator on both sides of the cockpit. If both sides select their respective cross-side navigation source, both NAV source annunciators will be yellow with no yellow box.

e. Lateral Course Deviation Scale. A lateral course deviation scale, consisting of four white circles and a center diamond, is located at the bottom of the display. The course deviation scale provides a reference for the course deviation bar to indicate the centerline of the selected navigation or localizer course in relation to the center diamond. The course width displayed in the composite mode is identical to that typically shown on the EHSI.

f. Lateral Course Deviation Bar. The course deviation bar represents the centerline of the selected navigation or localizer course. If invalid or failed primary NAV sensor data is received the course deviation bar and scale will be removed and a red X will be annunciated.

g. To / From Indicator. A white TO or FR is displayed to the left of the center diamond on the lateral deviation scale when in non-ILS modes.

h. Distance Information. Distance information is shown in an alphanumeric display, located in the lower left corner of the display. Distance in nautical miles from the aircraft to the selected primary NAV station when in the VOR, TACAN, or ILS mode, or to the waypoint in LNAV mode is displayed.

i. DME HOLD. When DME HOLD is selected the, DME distance and annunciator color changes to white and remains white until the HOLD function is released. The sensor identifiers (ADF, VOR, or ILS) retain their original color. The HOLD function is additionally annunciated by an orange H displayed immediately to the right of the distance information. Groundspeed and time to station are not displayed while DME HOLD is active.

NOTE

DME HOLD will not function when LNAV is the selected sensor.

Once DME is placed in HOLD, its distance continues to be displayed and is not affected when the primary NAV sensor is changed.

3A-23. ELECTRONIC FLIGHT INSTRUMENT SYSTEM REVERSIONARY MODES.

Three different reversionary modes of operation are provided for use in the event of a system component failure: composite, display down, and standby.

a. Composite Reversionary Mode. The composite reversionary mode is generally used to compensate for a failure of a display unit or the EADI section of the symbol generator. Pressing the respective pilot's or copilot’s composite switch indicator, placarded **CMPST**, located on the instrument panel, selects the composite display on the EADI or EHSI. The lower half of the **CMPST** switch illuminates DISP to indicate that the composite reversionary mode has been selected. Refer to Paragraph 3A-22 for a description of the composite mode displays.

b. Display Down Reversionary Mode. The display (EADI) down reversionary mode is generally used to compensate for a failure of the EADI display unit or the EADI section of the symbol generator. Pressing the respective pilot's or copilot’s **ADI** switch indicator, located on the instrument panel, transfers the normal EADI display to the MFD. The lower half of the **ADI** switch illuminates DOWN to indicate that the display down reversionary mode has been selected.

c. Standby Reversionary Mode. The standby (STBY) reversionary mode is generally used to compensate for a failure of the pilot's or copilot's symbol generator. Pressing the respective pilot's or copilot's **SG** switch indicator, located on the instrument panel, substitutes the MFD symbol generator for the failed symbol generator. The lower half of the **SG** switch illuminates STBY to indicate that the standby reversionary mode has been selected.

3A-24. VHF NAVIGATION RECEIVERS (KNR 634A).

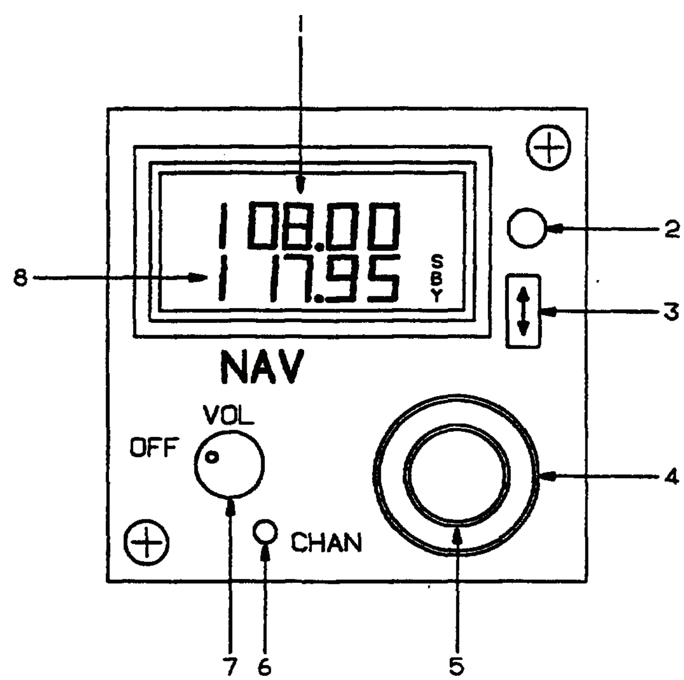
a. Introduction. Two VHF navigation receivers, combining VOR, localizer, glideslope, and marker functions, are installed. Each receiver provides 200 channels in the frequency range of 108.00 through 117.95 MHz (160 VOR channels and 40 localizer channels). Selection of VOR or localizer is automatic. Each receiver also provides 40 glideslope channels in the frequency range of 329.15 to 335.00 MHz and a marker receiver that operates at 75 MHz. The VHF navigation receivers are powered through the 2-ampere **NAV NO. 1** and **NO. 2** circuit breakers, located on the right sidewall circuit breaker panel, Figure 2-6.

b. VHF Navigation Receiver Control Unit (KFS 579A) Controls and Functions. The VHF navigation receiver control unit controls the number one VHF navigation receiver. The number two VHF navigation receiver is controlled by the NAV/TAC navigation receiver control unit. Refer to Figure 3A-19.

(1) Active Frequency Display. Displays the active frequency (frequency to which the receiver is tuned).

(2) Photocell. The built-in photocell automatically controls display brightness.

(3) Frequency Transfer Switch. The frequency transfer switch is a push-button switch that transfers the frequency in the standby display to the active display and the frequency in the active display to the standby display.



1. **Active Frequency Display**
2. **Photocell**
3. **Frequency Transfer Switch**
4. **Megahertz Tuning Knob**
5. **Kilohertz Tuning Knob**
6. **Channel Switch**
7. **Power and Volume Control**
8. **Standby Frequency Display**

Figure 3A-19. VHF Navigation Receiver Control Unit (KFS 579A)

Pressing the frequency transfer switch for more than 2 seconds, while in the standby entry mode, will switch the receiver control unit to the active entry mode.

Momentarily pressing the frequency transfer switch while in the active entry mode will return the receiver control unit to the standby entry mode.

(4) Megahertz Tuning Knob. The megahertz tuning knob is the larger of two concentric knobs that are used to set the frequency in the standby frequency display. Rotation of the megahertz tuning knob sets the three digits to the left of the decimal point in the standby frequency display. The numbers will roll over at the upper and lower frequency limits. Rotating the megahertz tuning knob in either direction with receiver control unit in the channel mode will change the channel number and its corresponding frequency.

(5) Kilohertz Tuning Knob. The kilohertz tuning knob is the smaller of two concentric knobs that are used to set the frequency in the standby frequency display. Rotation of the kilohertz tuning knob sets the two digits to the right of the decimal point in the standby frequency display in 50 kilohertz increments. The numbers will roll over at the upper and lower frequency limits. Rotating the kilohertz tuning knob in either direction with receiver control unit in the channel mode will change the channel number and its corresponding frequency.

(6) Channel Switch. The channel switch, placarded **CHAN**, is a push-button switch that will put the receiver control unit into the channel mode when momentarily pressed, or into the program mode when pressed for more than 2 seconds.

(7) Power and Volume Control. The power and volume control, placarded **OFF**/**VOL**, controls operation of the receiver control unit. Clockwise rotation from the **OFF** position applies power to the system and continued clockwise rotation increases volume.

(8) Standby Frequency Display. Displays the standby (inactive) frequency.

c. Operating Procedures.

(1) Equipment Turn On. The receiver and the control unit are turned on by clockwise rotation of the power and volume knob.

(2) Frequency Selection.

(a) Standby Frequency Entry Mode. When the receiver control unit is in the standby frequency entry mode, the active frequency (in the active frequency display) is selected by changing the frequency in the standby frequency display, then transferring the selected frequency to the active frequency display by pressing the frequency transfer switch. The frequency in the standby frequency display is changed by means of the megahertz and kilohertz tuning knobs on the receiver control unit. The receiver control unit will remain tuned to the frequency in the active frequency display as long as the receiver control unit is in the standby frequency entry mode.

(b) Active Frequency Entry Mode. When the receiver control unit is in the active frequency entry mode, the active frequency (in the active frequency display) is changed directly by rotating the kilohertz and megahertz tuning knobs. The receiver control unit is changed to the active frequency selection mode by holding the transfer switch pressed for longer than 2 seconds. Momentarily pressing the frequency transfer switch will change the receiver control unit back to the standby entry mode and will return the standby frequency display to the frequency displayed before entering the active frequency mode.

(c) Channel Mode. Pressing the channel switch, placarded **CHAN**, will put the receiver control unit into the channel mode. When the receiver control unit is in the channel mode, the channel number is displayed in the active frequency display and the channel frequency is displayed in the standby frequency display. Channel frequencies have to be set with the unit in the program mode.

When the receiver control unit is in the channel mode, the receiver will be tuned to the frequency that is displayed in the standby frequency display. If no channels have been programmed, the receiver control unit will display channel 1 (**CH 1**) with dashes in the standby frequency display for 5 seconds, then the unit will tune the receiver to the last frequency displayed in the active frequency display.

Pressing the transfer switch for 2 seconds will change the receiver control unit to the active frequency entry mode.

(3) Program Mode. The frequencies and channel numbers used in the channel mode must be programmed into memory with the receiver control unit in the program mode. Pressing the **CHAN** switch for longer than 2 seconds will put the receiver control unit into the program mode. The channel number that was last used will be displayed and flash in the active frequency display. With the channel number flashing, rotating the tuning knobs will change the channel number. A channel number with no programmed frequency will have dashes in the standby frequency

display. In this case the receiver will be tuned to the last valid frequency displayed in the active frequency display. Taking the receiver control unit out of the program mode with dashes in the standby frequency display will unprogram that channel. Pressing the frequency transfer switch will cause the channel number to stop flashing and the frequency to start flashing. The frequency can then be changed by rotating the tuning knobs. Pressing the frequency transfer switch again will cause the frequency to stop flashing and the channel to start flashing.

The receiver control unit will be returned to the standby frequency entry mode by pressing the **CHAN** switch or by a period of no activity for 20 seconds. The frequency mode prior to channel or program mode will be resumed, with the receiver tuned to the frequency in the active frequency display.

3A-25. TACAN SYSTEM (KTU 709).

a. Introduction. The TACAN system is a polar coordinate UHF navigation system that provides relative bearing and slant-range distance information with respect to a selected TACAN or VORTAC ground station. The effective range of the TACAN is limited to line of sight. Actual operating range depends on the altitude of the aircraft, weather, type of terrain, location and altitude of the ground transmitter, and transmitter power. The TACAN system is protected by a 3-ampere circuit breaker, placarded **TACAN**, located on the right sidewall circuit breaker panel, Figure 2-6.

b. VHF Navigation Receiver/TACAN System Control Unit (KFS 579A) Controls and Functions. Refer to Figure 3A-20.

(1) Active Frequency Display. Displays the active frequency or channel (frequency or channel to which the receiver is tuned).

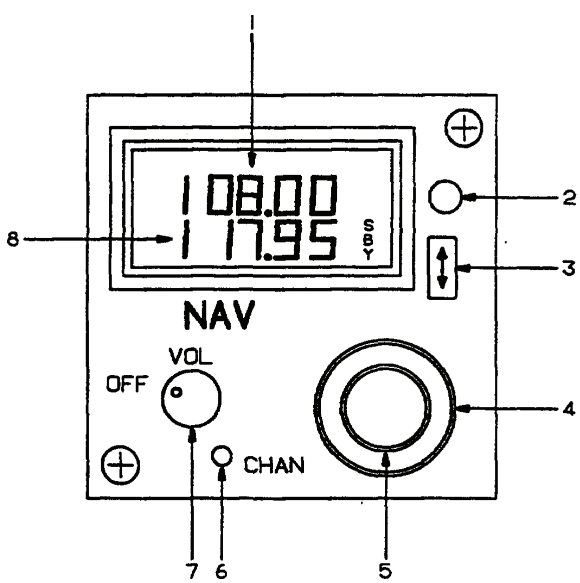
(2) Photocell. The built-in photocell automatically controls display brightness.

(3) Frequency Transfer Switch. The frequency transfer switch is a push-button switch that transfers the frequency or channel in the standby display to the active display and the frequency in the active display to the standby display each time it is pressed.

Pressing the frequency transfer switch for more than 2 seconds while in the standby entry mode will switch the receiver control unit to the active entry mode.

Momentarily pressing the frequency transfer switch while in the active entry mode will return the receiver control unit to the standby entry mode.

(4) TACAN Tens and Hundreds Digits and NAV Megahertz Digits Tuning Knob. The TACAN tens and hundreds digits and NAV megahertz digits knob is the smaller of two concentric knobs that are used to set the frequency or channel in the display. Rotation of the smaller tuning knob sets the two digits to the right of the decimal point in the standby frequency display in 50 kilohertz increments or the X and Y TACAN channels. X channels are selected with the knob in and Y channels are selected with the knob out. The numbers will roll over at the upper and lower frequency limits.



1. **Active Frequency Display**
2. **Photocell**
3. **Frequency Transfer Switch**
4. **Megahertz Tuning Knob**
5. **Kilohertz Tuning Knob**
6. **Channel Switch**
7. **Power and Volume Control**
8. **Standby Frequency Display**

Figure 3A-20. VHF Navigation Receiver/TACAN System Control Unit (KFS 579A)

(5) TACAN Units Digits, NAV Kilohertz, and TACAN X Or Y Tuning Knob. The TACAN units digits, NAV kilohertz, and TACAN X or Y tuning knob is the larger of the two knobs that are used to set the NAV frequency or TACAN channel in the standby frequency display. Rotation of this knob sets the three digits to the left of the decimal point in the standby frequency display or the 10's and 100's digits of a TACAN channel depending on the selected mode. The numbers will roll over at the upper and lower frequency or channel limits.

(6) Channel Switch. The channel switch, placarded **CHAN**, is a push-button switch, which is used to select whether TACAN channel or frequency is used in the active frequency or channel display.

(7) Power and Volume Control. The power and volume control placarded **OFF / VOL**, controls operation of the receiver control unit. Clockwise rotation from the **OFF** position applies power to the system and continued clockwise rotation increases volume.

(8) Standby Frequency Display. Displays the standby (inactive) frequency or channel.

c. Operating Procedures.

(1) Equipment Turn-On. The receiver and the control unit are turned on by clockwise rotation of the power and volume knob.

(2) Frequency Selection.

(a) Standby Frequency Entry Mode. When the receiver control unit is in the standby frequency or channel entry mode, the active frequency or channel, in the active frequency or channel display, is selected by changing the frequency or channel in the standby frequency display. Then transfer the selected frequency or channel to the active display by pressing the transfer switch. The frequency or channel in the standby frequency or channel display is changed by means of the tuning knobs on the control unit. The control unit will remain tuned to the frequency or channel in the active display as long as the control unit is in the standby entry mode.

(b) Active Frequency Entry Mode. When the receiver control unit is in the active frequency or channel entry mode, the active frequency or channel (in the active frequency or channel display) is changed directly by rotating the tuning knobs. The receiver control unit is changed to the active frequency or channel selection mode by holding the transfer switch pressed for longer than 2 seconds. Momentarily pressing the transfer switch will change the receiver control unit back to the standby entry mode and will return the standby frequency or channel display to the frequency or channel displayed before entering the active mode.

3A-26. AUTOMATIC DIRECTION FINDER (ADF) RECEIVER (KDF 806).

a. Description. The ADF receiver provides aural reception of signals from a selected ground station and indicates relative bearing to that station. The ground station must be within the frequency range of 190 to 1750 kHz. In the ANT mode, the ADF receiver functions as an aural receiver, providing only an aural output of the received signal. In ADF mode, it functions as an automatic direction finder receiver in which relative bearing to the station is presented on an associated bearing indicator, and an aural output of the received signal is provided. The ADF receiver is powered through a 2-ampere circuit breaker, placarded **ADF**, located on the right sidewall circuit breaker panel, Figure 2-6.

b. ADF Control Unit Operating Controls, Indicators, and Functions. Refer to Figure 3A-21.

(1) Active Frequency Display. Displays the active frequency (frequency to which the receiver is tuned).

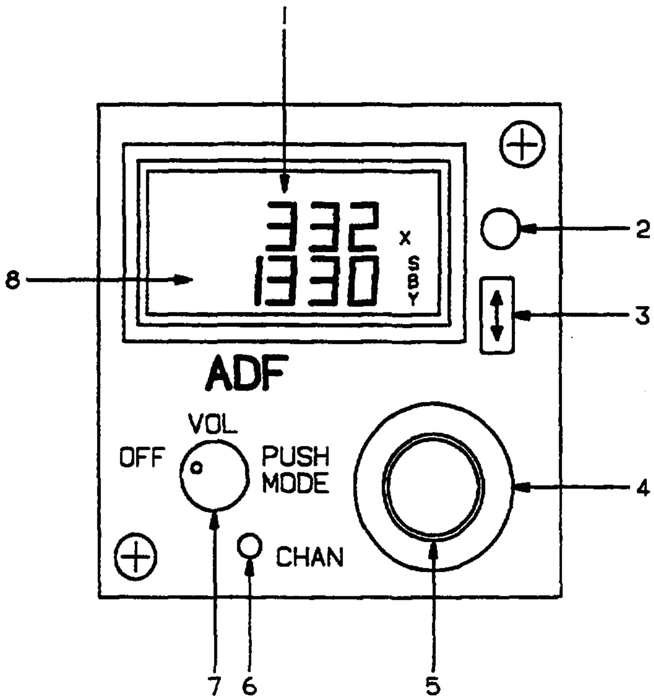
(2) Photocell. The built-in photocell automatically controls display brightness.

(3) Frequency Transfer Switch. The frequency transfer switch is a push-button switch that transfers the frequency in the standby display to the active display and the frequency in the active display to the standby display each time it is pressed.

Pressing the frequency transfer switch for more than 2 seconds while in the standby entry mode will switch the receiver control unit to the active entry mode.

Momentarily pressing the frequency transfer switch while in the active entry mode will return the receiver control unit to the standby entry mode.

(4) Kilohertz (100's) Tuning Knob. The kilohertz 100's tuning knob is the larger of two concentric knobs, which are used to set the frequency in the standby frequency display. Rotation of the larger tuning knob sets the 100's kilohertz digits in the standby frequency display. The numbers will roll over at the upper and lower frequency limits. Rotating the kilohertz 100's tuning knob in either direction with the receiver control unit in the channel mode will change the channel number and its corresponding frequency.



1. Active Frequency Display
2. Photocell
3. Frequency Transfer Switch
4. Kilohertz (100's) Tuning Knob
5. Kilohertz (10's and Pull Out for 1 to 10) Tuning Knob
6. Channel Switch
7. Power, Volume, and Mode Control Knob
8. Standby Frequency Display

Figure 3A-21. ADF Receiver Control Unit

(5) Kilohertz (10's and 1's) Tuning Knob. The kilohertz 10's and 1's tuning knob is the smaller of two concentric knobs, which are used to set the frequency in the standby frequency display. Rotation of the kilohertz tuning knob sets the 10's kilohertz digits in the standby frequency display. Rotating this knob while pulled out changes the 1 through 9-kilohertz portion of the frequency. The numbers will roll over at the upper and lower frequency limits. Rotating the kilohertz 10's and 1's tuning knob in either direction with the receiver control unit in the channel mode will change the channel number and its corresponding frequency.

(6) Channel Switch. The channel switch, placarded **CHAN**, is a push-button switch that will put the receiver control unit into the channel mode when momentarily pressed, or into the program mode when held pressed for more than 2 seconds.

(7) Power, Volume, And Mode Control. The power, volume, and mode control, placarded **OFF**, **VOL**, **PUSH MODE**, controls operation of the receiver control unit. Clockwise rotation from the **OFF** position applies power to the system and continued clockwise rotation increases volume.

(8) Standby Frequency Display. Displays the standby (inactive) frequency.

c. Operating Procedures.

(1) Equipment Turn On. The receiver and the control unit are turned on by clockwise rotation of the power and volume knob.

(2) Frequency Selection.

(a) Standby Frequency Entry Mode. When the receiver control unit is in the standby frequency entry mode, the active frequency (in the active frequency display) is selected by changing the frequency in the standby frequency display, then transferring the selected frequency to the active frequency display by pressing the frequency transfer switch. The frequency in the standby frequency display is changed by means of the kilohertz (hundreds) tuning knob and kilohertz (tens and ones) tuning knobs on the receiver control unit. The receiver control unit will remain tuned to the frequency in the active frequency display as long as the receiver control unit is in the standby frequency entry mode.

(b) Active Frequency Entry Mode. When the receiver control unit is in the active frequency entry mode, the active frequency (in the active frequency display) is changed directly by rotating the tuning knobs. The receiver control unit is changed to the active frequency selection mode by holding the transfer switch pressed for longer than 2 seconds.

Momentarily pressing the frequency transfer switch will change the receiver control unit back to the standby entry mode and will return the standby frequency display to the frequency displayed before entering the active frequency mode.

(3) Channel Mode. Pressing the channel switch, placarded **CHAN**, will put the receiver control unit into the channel mode. When in the channel mode, the channel number is displayed in the active frequency display and the channel frequency is displayed in the standby frequency display. Channel frequencies must be set with the unit in the program mode.

(a) When the receiver control unit is in the channel mode, the receiver will be tuned to the frequency that is displayed in the standby frequency display. If no channels have been programmed, the receiver control unit will display channel 1 (CH 1) with dashes in the standby frequency display for 5 seconds, then the unit will tune the receiver to the last frequency displayed in the active frequency display.

(b) Pressing the transfer switch for 2 seconds will change the receiver control unit to the active frequency entry mode.

(4) Program Mode. The frequencies and channel numbers used in the channel mode must be programmed into memory with the receiver control unit in the program mode.

(a) Pressing the **CHAN** switch for longer than 2 seconds will put the receiver control unit into the program mode. The channel number that was last used will be displayed flashing in the active frequency display. With the channel number flashing, rotating the tuning knobs will change the channel number. A channel number with no programmed frequency will have dashes in the standby frequency display. In this case the receiver will be tuned to the last valid frequency displayed in the active frequency display. Taking the receiver control unit out of the program mode with dashes in the standby frequency display will deprogram that channel. Pressing the frequency transfer switch will cause the channel number to stop flashing and the frequency to start flashing. Change the frequency by rotating the tuning knobs. Pressing the frequency transfer switch again will cause the frequency to stop flashing and the channel to start flashing.

(b) The receiver control unit will return to the standby frequency entry mode by pressing the **CHAN** switch or a period of no activity for 20 seconds. The frequency mode prior to channel or program mode will be resumed, with the receiver tuned to the frequency in the active frequency display.

d. Normal Operation.

1. Power and mode switch – ANT, ADF, or TONE (BFO).

2. Tuning knobs – Set desired frequency.

3. ANT function – Position power and mode switch to ANT. Select ADF on audio system and adjust volume.

4. ADF function – Position power and mode switch to ADF. Bearing pointer will indicate relative bearing to tuned station.

5. TONE function – Position power and mode switch to TONE (BFO). A 1000-Hz tone will identify keyed CW stations.

(1) Self-Test.

1. Power and Mode Switch – ADF.

2. Tuning Knobs – Tune a nearby NDB, compass locator, or broadcast station.

3. Power, Volume, and Mode Control Knob – Press to begin test. Bearing pointer will rotate 90° from the previous valid indication. Press again and verify that the bearing pointer returns to previous valid indication.

NOTE

If the signal received is weak or of poor quality, bearing pointer rotation will be slow.

3A-27. RADIO MAGNETIC INDICATORS (KNI 582).

a. Description. The pilot and copilot are each provided with an identical Radio Magnetic Indicator (RMI), which provides aircraft magnetic heading and radio bearing information to a selected VOR, TACAN, NDB, or FMS waypoint. The RMI's are powered through two 1-ampere circuit breakers, placarded, **RMI NO. 1** and **NO. 2**, located on the right sidewall circuit breaker panel, Figure 2-6.

b. RMI Controls and Functions (KNI 582). Refer to Figure 3A-22.

(1) Heading Flag. The heading flag comes in to view when heading information displayed on the compass card is invalid.

(2) Lubber Line. Aircraft heading is read from the compass card under the lubber line.

(3) Double Bar Pointer. The double bar pointer displays the magnetic heading to the selected VOR, TACAN, NDB, or FMS waypoint.

(4) Compass Card. This rotating card repeats gyro stabilized magnetic compass information. Aircraft heading is read from the compass card under the orange lubber line.

*(5) Double Bar Pointer **ADF / NAV** Push-Button Selector Switch*. The double bar pointer **ADF/NAV** push-button selector switch is used to select the NAV system providing bearing information to the double bar pointer.

*(6) Single Bar Pointer **ADF / NAV** Push-Button Selector Switch*. The single bar pointer **ADF**/**NAV** push-button selector switch is used to select the NAV system providing bearing information to the single bar pointer.

(7) Single Bar Pointer. The single bar pointer displays the magnetic heading to the selected VOR, TACAN, NDB, or FMS waypoint.

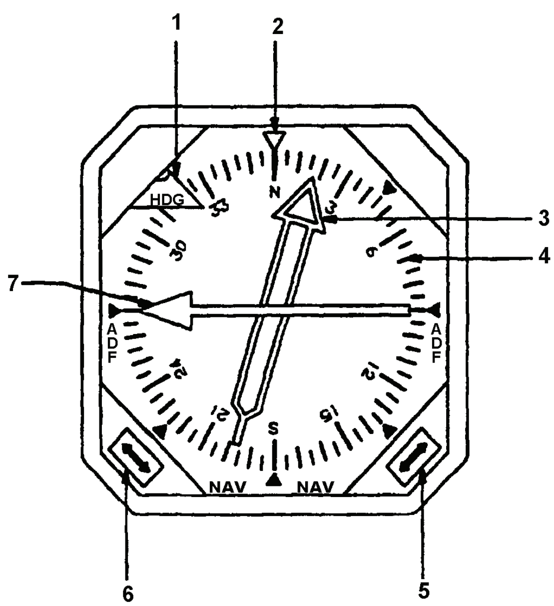
3A-28. FLIGHT MANAGEMENT SYSTEM (GNS-XLS).

a. Description. The flight management system is an integrated system that provides the flight crew with centralized control of the navigation sensors, flight planning, fuel management, and frequency management for most avionics. The system uses a full-color flat panel Liquid Crystal Display (LCD), an alphanumeric and function keyboard, a Global Positioning System (GPS) sensor, and a navigation database.

b. Database. An electronic database is loaded into the flight management system at the time of manufacture. The database includes current worldwide navaids and airport reference points for all airports with runways of 3,000 feet or greater. The database includes the following.

(1) VHF Navaids. All VHF ground based navaids including the following.

1. VOR/DME stations.
2. VOR only stations.
3. DME only stations.
4. VORTAC stations.
5. TACAN stations.
6. ILS/DME stations.



1. Heading Flag
2. Lubber Line
3. Double Bar Pointer
4. Compass Card
5. Double Bar Pointer ADF/NAV Push-Button Selector Switch
6. Single Bar Pointer ADF/NAV Push-Button Selector Switch
7. Single Bar Pointer

Figure 3A-22. Radio Magnetic Indicator (RMI)

(2) Airport Reference Points. All airports with hard surfaced runways longer than 2,000 feet.

(3) Waypoints, Intersections, and Approaches.

1. High altitude waypoints.

2. Low altitude waypoints.

3. Standard Instrument Departure (SID) waypoints.

4. Standard Terminal Arrival Route (STAR) waypoints.

5. Approach intersections.

6. Non-precision approaches.

(4) Database Revisions. System owners are shipped database revision every 28 days in the form of an electronic memory card for the first year from the date of warranty registration, and by subscription thereafter.

c. Controls, Indicators, and Functions (GNS-XLS Control-Display Unit). Refer to Figure 3A-23.

(1) Navigation Key. Pressing the navigation key, placarded **NAV,** will cause the first page of the navigation section to be displayed on the flight management system control-display unit. The next sequential page in the navigation section will be displayed with each subsequent press of the navigation key.

(2) Vertical Navigation Key. Pressing the vertical navigation key, placarded **VNAV**, will cause the first page of the vertical navigation section to be displayed on the flight management system control-display unit. The next sequential page in the vertical navigation section will be displayed with each subsequent press of the vertical navigation plan key.

(3) Airborne Flight Information Key.

NOTE

Airborne Flight Information System (AFIS) is not installed in Army aircraft.

Pressing the key placarded AFIS will cause a message, NOT INSTALLED to be displayed on the flight management system control display unit.

(4) Flight Plan Key. Pressing the flight plan key, placarded FPL, will cause the first page of the flight plan section to be displayed on the flight management system control-display unit. The next sequential page in the flight plan section will be displayed with each subsequent press of the flight plan key.

(5) Power Key. Pressing the power key, placarded **ON**, will apply power to the system. After a warmup period of approximately 5 minutes, the display will initially appear at maximum brightness. Pressing the power key for approximately 3 seconds will initiate the system power off sequence. During the sequence, the display will annunciate, SYSTEM TURNING OFF. This time delay and annunciation are designed to prevent inadvertent system shutdown.

NOTE

The flight management system may be left on and turned on and off by the AVIONICS MASTER PWR switch.

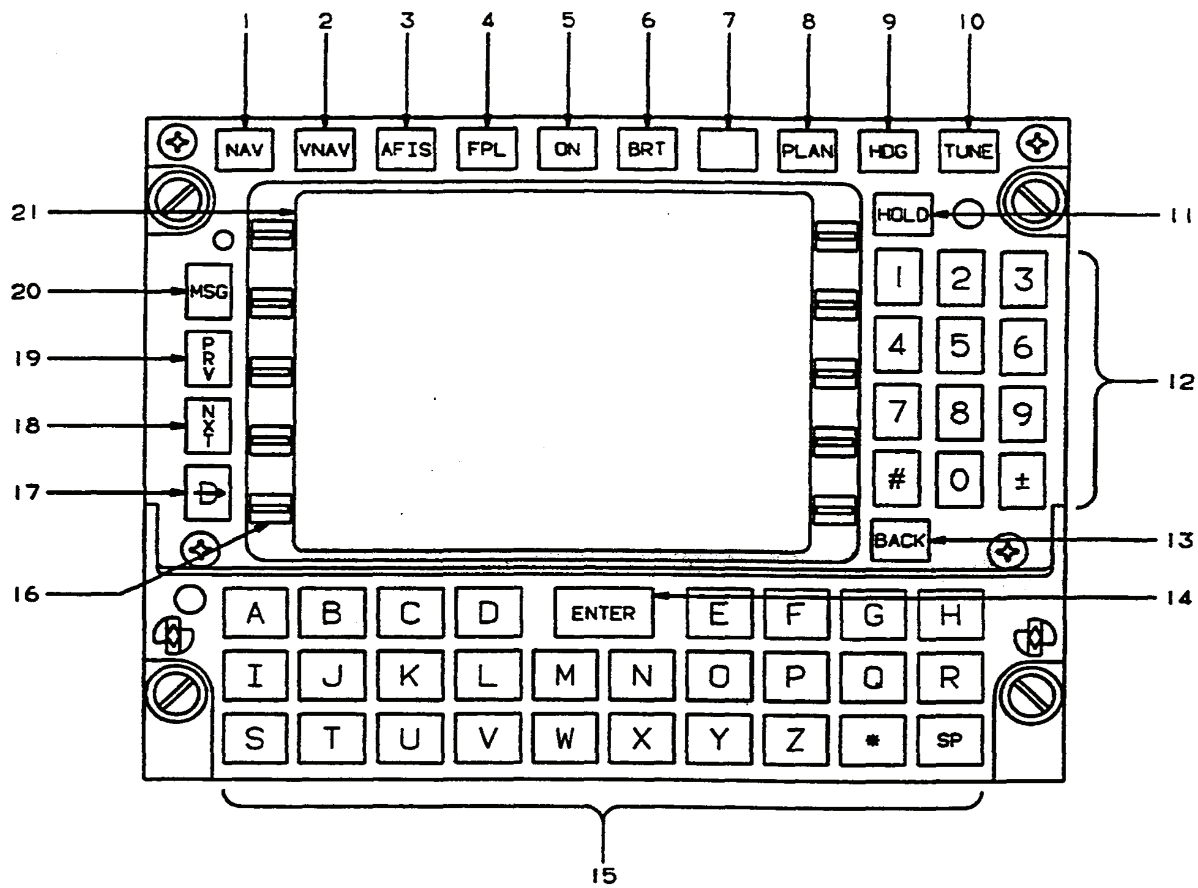
(6) Brightness Key. Pressing the brightness key, placarded **BRT**, will change the illumination of the flight management system control-display unit. The flight management system display will initially come on at full brightness when power is applied. Hold the brightness key pressed to dim the display to the desired level. The brightness key is also used to align the line selection keys.

(7) Blank Key. This key is not used in this installation.

(8) Planning Key. Pressing the planning key, placarded **PLAN,** will cause the first page of the planning procedures section to be displayed on the flight management system control-display unit. The next sequential page in the planning procedures section will be displayed with each subsequent press of the planning key.

(9) Heading Key. Pressing the heading key, placarded **HDG**, will cause the heading section page to be displayed on the flight management system control-display unit.

(10) Tuning Key. Pressing the tuning key, placarded **TUNE**, will cause the first page of the remote tuning section to be displayed on the flight management system control-display unit. The next sequential page in the remote tuning section will be displayed with each subsequent press of the tuning key.



1. **Navigation Display Selector Key**
2. **Vertical Navigation Display Selector Key**
3. **Airborne Flight Information System Display Selector Key**
4. **Flight Plan Display Selector Key**
5. **Power ON/Off Key**
6. **Display Brightness Adjustment Key**
7. **Not Used**
8. **Planning Display Selector Key**
9. **Heading Display Selector Key**
10. **Tuning Display Selector Key**
11. **Holding Key**
12. **Numeric Keys**
13. **BACK Key**
14. **ENTER Key**
15. **Letter Keys**
16. **Line Select Keys**
17. **Direct To Key**
18. **Next Page Key**
19. **Previous Page Key**
20. **Message Key/Annunciator**
21. **Display Screen**

Figure 3A-23. Flight Management System Control Display Unit (GNS-XLS)

(11) Holding Key. Pressing the holding key, placarded **HOLD**, will cause the first page of the navigation section to be displayed on the flight management system control-display unit if the cursor is positioned over a waypoint identifier, and it is appropriate to program a holding pattern or procedure turn at that waypoint. If the cursor is not displayed, pressing the holding key will access the position fix page and is used for position updates and verification as well as entering the primary navigation mode.

(12) Numeric Keys. The numeric keys are used to enter numbers 0 through 9, #, and ± sign.

(13) Back Key. The back key, placarded **BACK**, is used to erase errors and page backward when the cursor is not displayed.

(14) ***ENTER*** *Key.* Pressing the **ENTER** key will enter displayed data into the computer memory.

(15) Alpha Keys. The alpha keys are used to enter the 26 letters of the alphabet and the asterisk.

(16) Line Select Keys. Pressing a line select key will place the cursor in the field next to that key. Dots displayed on the sides of the display indicate active line select keys for each individual page. Pressing the **ENTER** key will display the next step of the highlighted selection.

(17) Direct To Key. Pressing the direct to key, placarded -D►, will cause the first page of the direct to section to be displayed on the flight management system control-display unit. The next sequential page in the direct to section will be displayed with each subsequent press of the -D► key.

(18) Next Page Key. Pressing the next key, placarded **NXT**, will cause the next page of a section or subsection to be displayed on the flight management system control-display unit.

(19) Previous Page Key. Pressing the previous key, placarded **PREV**, will cause the previous page of a section or subsection to be displayed on the flight management system control-display unit.

(20) Message Key/Message Annunciator. The message annunciator will flash to alert the crew that a message needs to be viewed on one of the System Messages or Sensor Messages pages.

Pressing the message key, placarded **MSG**, will display the message. The newest message will be indicated by a flashing asterisk. If the message requires action to be taken by the crew, the message annunciator will remain steadily illuminated until the action is completed. If no action is required, the message annunciator will extinguish when the message page is exited.

(21) Display. Flat panel color liquid crystal display. The display is color coded to assist the crew in recognizing information as follows.

(a) Magenta. Magenta is used for to waypoint, VNAV, and TGT speeds.

(b) Cyan. Cyan is used for date and time, tuned frequencies or codes, GRI's, and altitudes.

(c) Green. Green is used for navigation, fuel data, and general page data.

(d) Red. Red is used for warnings.

(e) Blue. Blue is used for waypoint numbers.

d. Pages Displayed at Power-Up.

(1) Self-Test Page. The Self-Test page, Figure 3A-24, appears when power is applied to the system. While the Self-Test page is displayed, the computer performs a self-test that must be successfully completed before proceeding. If a problem is detected, the SELF-TEST display may be replaced by a NO DATA RECEIVED message.

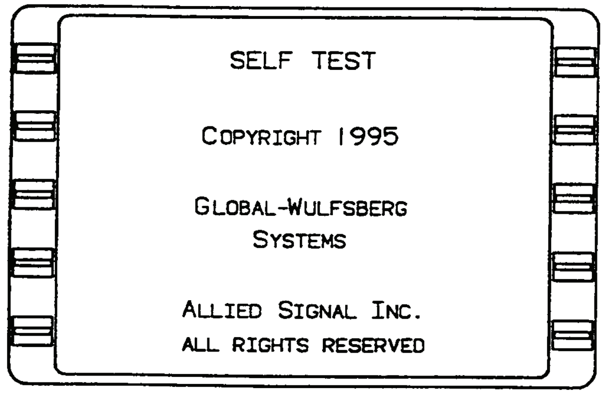


Figure 3A-24. FMS Self-Test Page

(2) Initialization Page. After the self-test is completed, the Initialization page, Figure 3A-25, will display.

NOTE

The Initialization page cannot be recalled once DATE, GMT, and POS have been entered. The Initialization page may be displayed again by removing and then re-applying power to the system.

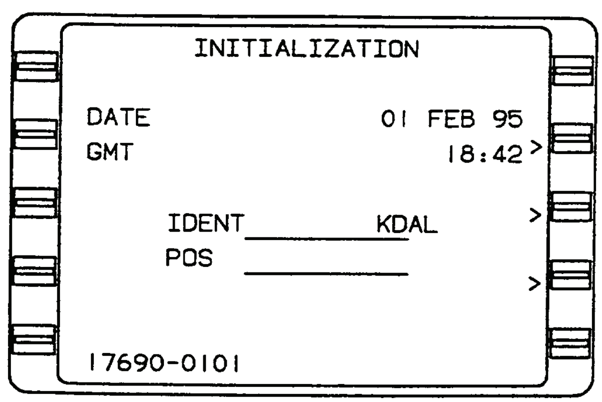


Figure 3A-25. FMS Initialization Page

(a) DATE. This line displays the current Greenwich date (day, month, and year). When the date is entered, the numerals 01 through 12 are entered for the months. The computer changes this month designation to its alpha equivalent.

(b) GMT. This line displays the time of day in Greenwich Mean Time in hours and minutes.

(c) IDENT. This line displays the airport identifier of the nearest airport to the aircraft's position at shutdown. Dashes will be displayed in this line when the aircraft's position coordinates are displayed on the POS lines.

(d) POS. This line displays the aircraft's position at shutdown. Dashes will be displayed in this line if an airport identifier is displayed on the IDENT line.

(e) Software Status. The bottom line of the display shows the unit part number and the software modification status number.

e. Navigation Section (NAV Key).

(1) Navigation 1/4 Page. Refer to Figure 3A-26.

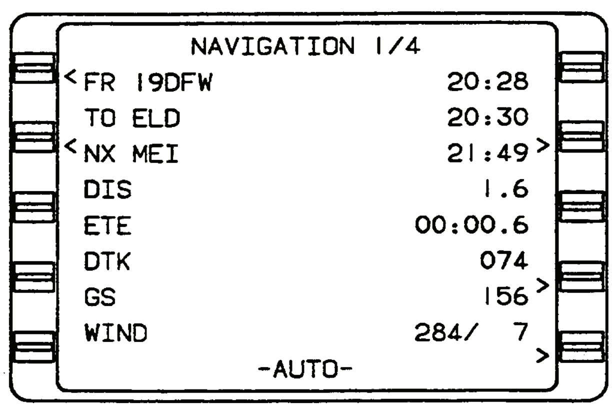


Figure 3A-26. FMS Navigation 1/4 Page

(a) FR, DIRECT, HOLD, PROCEDURE TURN, DME ARC, or PSEUDO VORTAC Line.

1 *FR.* If FR (from) is displayed on this line, the From waypoint identifier will be displayed on the left and the time of departure from or overhead at that waypoint will be displayed in the right field.

2 *DIRECT.* DIRECT displayed on this line indicates that the system is navigating to the next waypoint via a direct route. The time overhead at the last waypoint will be displayed on the right field.

3 *HOLD.* This line indicates that a holding pattern has been initiated. RIGHT or LEFT displayed on the left side of the field indicates the direction of turns to fly the pattern as entered on the Hold page. MANUAL or AUTO on the right side of the field indicates the programmed exit mode as entered on the Hold page. Selecting MANUAL initiates a continuous hold at the fix until action is taken by the crew to exit the hold. Selecting **AUTO** executes an exit the second time the aircraft passes over the fix. The system then sequences to the next waypoint on the flight plan. This field can be edited by using the **BACK** key.

4 *PROCEDURE TURN.* Indicates that a procedure turn has been initiated.

5 *DME ARC.* Indicates that a DME arc has been initiated.

6 *PSEUDO VORTAC.* Indicates that a system is navigating to a pseudo VORTAC. This line displays the from (FR) waypoint identifier on the left with the time of departure or time overhead at that waypoint displayed on the right. This line can also display DIRECT, HOLD, PROCEDURE TURN, DME ARC, or PSEUDO VORTAC.

(b) TO, AR, HP, or PT Line.

1 *TO.* When TO is displayed on this line, the TO waypoint identifier will be displayed in the left field and the ETA at that waypoint will be displayed in the right field.

2 *AR (DME Arc).* When AR (DME arc) is displayed on this line, the identifier of the DME arc waypoint being flown to will be displayed in the left field and the ETA at that waypoint will be displayed in the right field.

NOTE

When the system is flying a DME ARC, the displayed data will momentarily show dashes as the system changes arc segments and new computations are made.

3 *HP (Holding Pattern).* HP displayed on this line indicates that a holding pattern has been programmed at the waypoint being flown to. The to HP waypoint identifier being flown to will be displayed in the left field and the ETA at that waypoint will be displayed in the right field.

4 *PT (Procedure Turn).* PT displayed on this line indicates that a holding pattern entry with an auto exit is programmed at a waypoint. The FMS will fly the appropriate entry the first time over the PT waypoint. The next time over the waypoint, the system will sequence to the following waypoint on the flight plan.

(c) NX, HDG SELECT, or INTERCEPT HDG Line.

1 *NX.* Displays the next waypoint identifier on the active flight plan in the left field and the ETA at that waypoint in the right field. This line is displayed during waypoint alert only.

2 *HDG SELECT.* HDG SELECT will be annunciated when heading mode has been selected but with no intercept. Commanded heading and turn direction will be annunciated in the right field.

3 *INTERCEPT HDG.* INTERCEPT HDG will be annunciated when heading mode has been selected and will intercept the next leg. Commanded heading and turn direction will be annunciated in the right field.

(d) DIS. This line displays the distance in nautical miles and tenths of miles from the aircraft's present position to the to waypoint. During waypoint alert, the distance in whole nautical miles to the next (NX) waypoint is displayed in parentheses.

(e) ETE. This line displays the estimated time en route in hours, minutes, and tenths of minutes, from the aircraft's present position to the to waypoint based on current groundspeed.

(f) DTK. This line displays the desired track (DTK). The DTK is the great circle course in whole degrees between the FROM and TO waypoints. When in the PSEUDO VORTAC mode, the desired track is entered by the crew. During a waypoint alert, desired track to the next waypoint is displayed in parentheses.

NOTE

Dashes will be displayed in the DTK field if the FROM waypoint or present position are north of N 70° or south of S 60° latitude, unless a manual magnetic variation (MAG VAR) is entered or a discrete MAG / TRUE switch is moved to the TRUE position.

(g) GS. This line displays the current groundspeed.

(h) WIND. This line displays the current wind direction referenced to true north, and wind speed in knots.

(i) AUTO. This line displays the selected leg change mode. Automatic (AUTO) or manual (MAN**)** may be selected by using the **BACK** key.

(2) Navigation 1/4 (With Programmed Holding Pattern).

(a) HOLD. This line indicates that a holding pattern has been initiated. RIGHT or LEFT displayed on the left side of the field indicates the direction of turns to fly the pattern as entered on the Hold page. MANUAL or AUTO on the right side of the field indicates the programmed exit mode as entered on the Hold page. Selecting manual initiates a continuous hold at the fix until action is taken by the crew to exit the hold. Selecting **AUTO** executes an exit the second time the aircraft passes over the fix. The system then sequences to the next waypoint on the flight plan. This field can be edited by using the **BACK** key.

(b) AT. This line displays the identifier of the holding fix for the holding pattern in use on the left side, and the ETA of the next time over the holding fix. This line can also display the following.

1 *HP.* This line displays the identifier of the holding fix for which a holding pattern is programmed in the left field with the ETA at the holding fix in the right field.

(c) PT. This line displays the identifier of the holding fix for which a procedure turn is programmed in the left field with the ETA over the holding fix in the right field.

(d) AR. This line displays the identifier of the holding fix for which a DME arc is programmed in the left field with the ETA over the fix in the right field.

(e) Holding Status Message.

1 *DIRECT ENTRY.* This display message indicates that the system will use a direct entry into the holding pattern. This message will appear 30 seconds prior to entering the holding pattern. The display message will change to HOLDING after crossing the holding fix.

2 *TEARDROP ENTRY.* This display message indicates that the system will use a teardrop entry into the holding pattern. This message will

appear 30 seconds prior to entering the holding pattern. The display message will change to HOLDING after crossing the holding fix the second time.

3 *PARALLEL ENTRY.* This display message indicates that the system will use a parallel entry into the holding pattern. This message will appear 30 seconds prior to entering the holding pattern. The display message will change to HOLDING after crossing the holding fix the second time.

4 *HOLDING.* This message is normally displayed while holding.

5 *EXIT HOLD.* This message indicates that the system will exit the holding pattern the next time over the holding fix. The estimated time en route to the holding fix is also displayed.

(f) DIS. This line displays the distance in nautical miles and tenths of nautical miles from the aircraft's present position to the holding fix.

(g) ETE. This line displays the estimated time en route until the next time over the holding fix based on the path around the holding pattern.

(h) INBOUND CRS. This line displays the inbound holding course (INBOUND CRS) in degrees.

(i) GS. This line displays the current groundspeed.

(j) WIND. This line displays the current wind direction referenced to true north, and wind speed in knots.

NOTE

The leg change mode (AUTO or MANUAL) will not be displayed while holding.

(3) Navigation 2/4 Page. Refer to Figure 3A-27.

(a) FR, DIRECT, HOLD, PROCEDURE TURN, DME ARC, or PSEUDO VORTAC Line. Same as in Navigation 1/4 page.

(b) TO, AR, HP, or PT Line. Same as in Navigation 1/4 page.

(c) NX, HDG SELECT, or INTERCEPT HDG Line. Same as in Navigation 1/4 page.

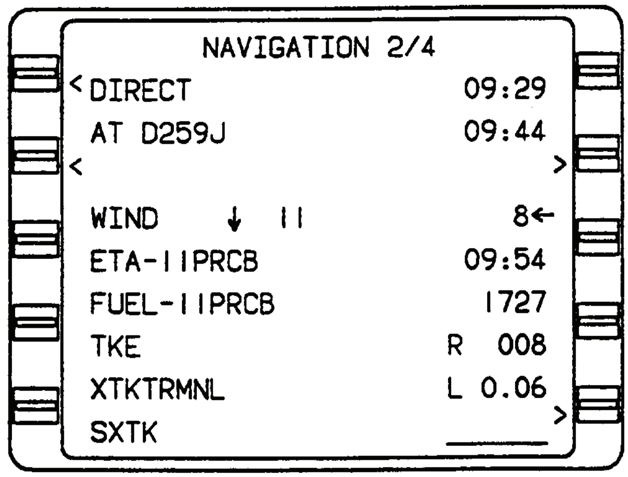


Figure 3A-27. FMS Navigation 2/4 Page

(d) WIND. The first field in the wind line displays headwind or tailwind in knots preceded by an up arrow for a tailwind or a down arrow for a headwind. The second field displays the crosswind component in knots followed by a right pointing arrow for a left crosswind or a left pointing arrow for a right crosswind.

(e) ETA. This line displays the estimated time of arrival at the last waypoint on the active flight plan.

(f) FUEL. This line displays the estimated fuel that will be remaining at the destination.

(g) TKE. Track error (TKE) is the difference between the desired track and the actual track in degrees. R (right) or L (left) is displayed preceding the track error in degrees to show the direction of error in relation to the desired track.

(h) XTK. Crosstrack (XTK) distance is the lateral displacement of the aircraft in nautical miles and tenths of a nautical mile to the left or right of the desired track (125 NM maximum). TRMNL, APRCH, or ENRTE will be displayed following XTK to indicate the approach mode that the system is presently using.

1 *TRMNL.* TRMNL will be displayed following XTK to show that the system is operating in the terminal approach mode.

2 *APRCH.* APRCH will be displayed following XTK to show that the system is operating in the approach mode.

3 *ENRTE.* ENRTE will be displayed following XTK to show that the system is operating in the en route approach mode.

(i) SXTK. SXTK is the selected crosstrack distance entered by the flight crew to provide steering to an offset course parallel to the desired track (99.9 NM maximum).

(4) Navigation 3/4 Page. Refer to Figure 3A-28.

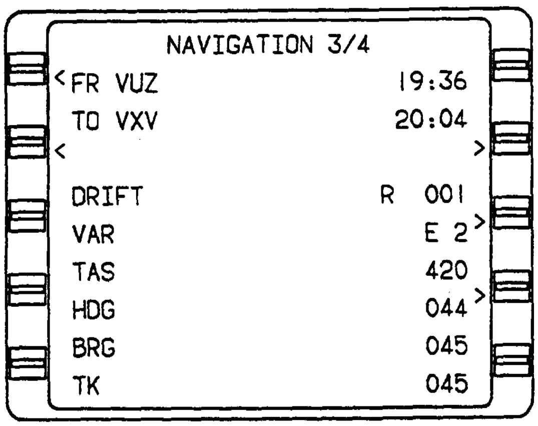


Figure 3A-28. FMS Navigation 3/4 Page

(a) FR, DIRECT, HOLD, PROCEDURE TURN, DME ARC, or PSEUDO VORTAC Line. Same as in Navigation 1/4 page.

(b) TO, AR, HP, or PT Line. Same as in Navigation 1/4 page.

(c) NX. HDG SELECT or INTERCEPT HDG line. Same as in Navigation 1/4 page.

(d) DRIFT. DRIFT angle is the angular difference between aircraft heading and the direction it is moving over the ground. Drift angle is displayed in degrees to the right or left of aircraft heading in the right field.

(e) VAR. The magnetic variation (VAR) in degrees is displayed in the right field preceded by an E (east) or a W (west). The flight management system automatically computes the magnetic variation between latitude N 70 00.00 degrees and latitude S 60 00.00 degrees. Manual variation may be entered. When manual variation is entered, it overrides the automatic computation, and is indicated by MAN.

(f) TAS. The TAS line displays the aircraft's true airspeed in knots from the air data computer. If true airspeed is manually inserted, MAN will be displayed.

(g) HDG. The HDG line displays the aircraft's heading in degrees from the aircraft's compass system. If heading is manually inserted, MAN will be displayed.

(h) BRG. The BRG line displays the aircraft's bearing in degrees from the aircraft's present position to the TO waypoint.

(i) TK. The TK line displays the aircraft's track angle in degrees.

(5) Navigation 4/4 Page. Refer to Figure 3A-29.

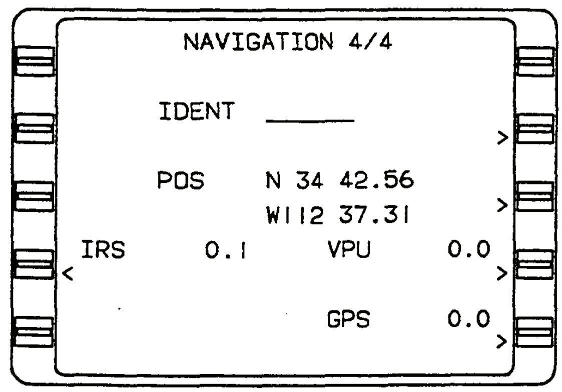


Figure 3A-29. FMS Navigation 4/4 Page

(a) IDENT. The IDENT field displays the waypoint identifier of a fix to be overflown for position update.

(b) POS. The POS (position) fields display the current composite latitude and longitude in degrees, minutes, and hundredths of a minute.

(c) GPS. The GPS sensor will be listed with the radial difference between the individual sensor position and the composite position displayed in nautical miles and tenths of a nautical mile.

NOTE

The Sensor Message pages may be accessed by placing the cursor over the individual position sensor and pressing the ENTER key. Use the NAV, PRV, or NXT key to page through the sensor status pages. When all of the sensor status pages have been reviewed, Navigation 1/4 page will again be displayed.

f. GPS Subsection Pages.

(1) GPS Subsection 1/3 Page. Refer to Figure 3A-30.

(a) POS. The POS (position) fields display the current composite latitude and longitude in degrees, minutes, and hundredths of a minute.

(b) GPS. The GPS (global positioning system) fields display current GPS latitude and longitude in degrees, minutes, and hundredths of a minute. GPS position is only displayed when GPS is in the NAV mode.

(c) DIF. The DIF (difference) between the composite position and the sensor computed latitude and longitude in degrees.

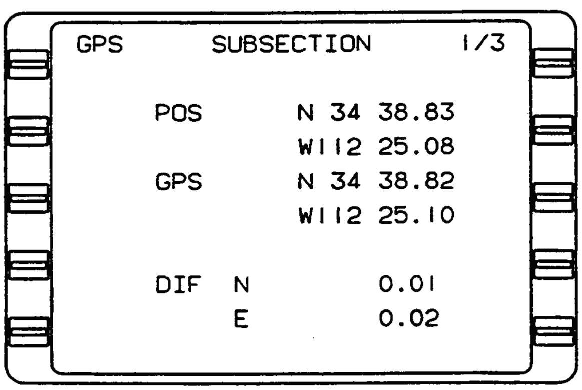


Figure 3A-30. GPS Subsection 1/3 Page

(2) GPS Subsection 2/3 Page. Refer to Figure 3A-31.

(a) GPS HPE. The GPS HPE (horizontal position error) field displays horizontal position error in nautical miles.

(b) GPS TIME. The GPS TIME field displays GPS GMT in hours, minutes, and seconds. This time is displayed when at least one satellite is being tracked, otherwise the time field displays dashes.

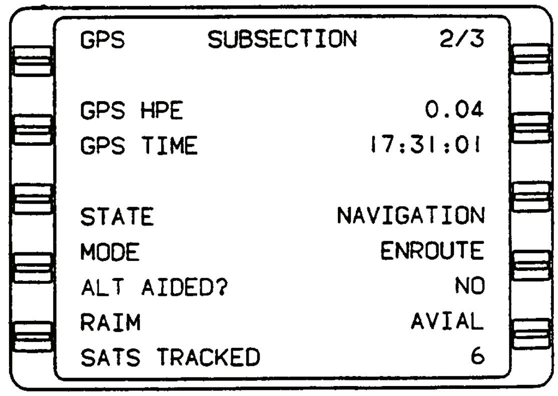


Figure 3A-31. GPS Subsection 2/3 Page

NOTE

GPS TIME may vary by several seconds from GMT due to leap second input of UTC (coordinated universal time).

(c) STATE. This field displays the GPS receiver state.

1 *Dashes* – GPS receiver is idle or no mode data is available.

2 *INITIALIZE* – The GPS receiver is updated with initial position and time information.

3 *SKY SEARCH* – No almanac available. The GPS system is searching for any satellite in the visible table based on the internal or external time, data, and position and will assign channels in the order received.

4 *ACQUISITION* – Constellation selection, channel assignments, and carrier and code lock are in progress.

5 *TRANSITION* – The GPS receiver is transitioning from one state to another.

6 *NAVIGATION* – GPS receiver is in navigation mode and has at least a two-dimensional position fix.

7 *DR* – The GPS system is in the Dead Reckoning (DR) mode. When GPS position is valid and sufficient satellite measurements are unavailable, the GPS receiver will continue to output valid position information for a maximum of

30 seconds while using the last known velocity and track information. The position will be invalid after 30 seconds.

(d) MODE. This line displays current GPS receiver mode of operation.

1 *EN ROUTE* – GPS receiver is operating in the EN ROUTE mode.

2 *TERMINAL* – GPS receiver is operating in the TERMINAL mode.

3 *APPROACH* – GPS receiver is operating in the APPROACH mode.

(e) ALT AIDED?. This line indicates whether or not the GPS receiver is using an externally supplied altitude for position calculation.

(f) RAIM. This line indicates whether GPS RAIM (receiver autonomous integrity monitoring) is available (AVAIL) or unavailable (UNAVAIL).

(g) SATS TRACKED. This line indicates the number of satellites that the GPS receiver is currently tracking.

(3) GPS Subsection 3/3 Page. This page displays the status of the GPS receiver. Refer to Figure 3A-32. The GPS receiver is an eight-channel receiver. Information on up to eight satellites can be displayed under six column titles as follows.

(a) GPS SAT. This field displays GPS satellite Pseudo Random Noise (PRN) number.

(b) AZ. This field displays GPS satellite azimuth (AZ) position in degrees.

(c) EL. This field displays GPS satellite elevation (EL) in degrees above the horizon.

(d) SNR. This field displays GPS satellite Signal To Noise Ratio (SNR).

(e) HLTH. This field displays GPS satellite health (HLTH) as BAD or GOOD.

(f) T. This field indicates whether or not GPS satellite is being tracked (T) by displaying Y (yes) or N (no).

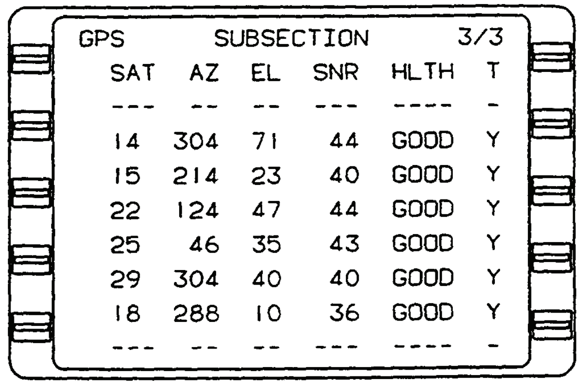


Figure 3A-32. GPS Subsection 3/3 Page

g. Vertical Navigation Section (VNAV Key).

NOTE

VNAV system is advisory only, it is not coupled to the autopilot.

In a programmed approach, the altitude displayed with the MAP (missed approach point) waypoint is computed through the MAP waypoint to a point 50 feet above the runway threshold. MDA (Minimum Descent Altitude) may be reached prior to the MAP waypoint. MDA must be observed if the runway is not in sight.

(1) VNAV 1/3 (Path) Page. Refer to Figure 3A-33.

(a) VNAV Mode (First Line of Display Below Title). The VNAV mode is the mode required to fly to the TO waypoint and is displayed in the left field. The aircraft's current barometric altitude in feet is displayed in the right field. The VNAV mode line can display the following.

1 *INVALID.* INVALID displayed in the VNAV mode line indicates that the VNAV function is invalid. In order to be valid, the following conditions must be met.

a. Air data (barometric altitude and altitude rate) must be valid.

b. Must have a valid lateral to waypoint.

c. Must have a valid vertical to waypoint.

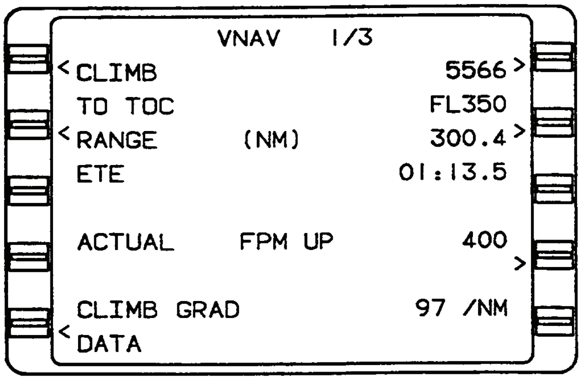


Figure 3A-33. VNAV 1/3 Page

d. No SXTK (selected crosstrack) may be programmed.

e. Cross track must be less than 12.5 nautical miles.

2 *INACTIVE.* INACTIVE displayed in the VNAV mode line indicates that the VNAV function is not activated.

NOTE

A crosstrack (XTK) of more than 125 nautical miles will cause VNAV mode to be inactive.

When VNAV mode is inactive all external VNAV outputs are disabled, including VERT DEV, EFIS altitude constraints at waypoints, and VNAV WPT ALERT annunciation.

3 *CLIMB.* When CLIMB is displayed on this line, the altitude that must be gained to reach cruise altitude or to the next altitude restriction is shown in the right field.

4 *CRUISE.* When CRUISE is displayed on this line, the altitude that must be maintained while en route to the top of descent (#TOD) point will be shown in the right field.

5 *PATH DESCENT.* PATH DESCENT displayed on this line indicates a descent via a programmed flight path angle. Vertical deviation (VERT DEV) will be enabled on the glideslope needle on EHSI.

6 *DESCENT.* DESCENT displayed on this line indicates non-path or air mass descent to altitude restriction.

7 *LEVEL.* LEVEL displayed on this line indicates that the aircraft should fly level to the next altitude constraint.

(b) TO Waypoint Line (Second Line). This line displays the vertical TO waypoint with the constraint altitude and applicable waypoint offset, where FL = flight level, A = at or above, B = at or below, G = glide path, and a blank space = at constraint altitude.

1 *#TOC.* #TOC displayed on this line will have the top of climb target cruise altitude displayed in the right field, the top of climb will become the vertical to waypoint once the aircraft has passed the final climb restriction waypoint and is still climbing.

2 *#TOD.* #TOD displayed on this line will have the top of descent target cruise altitude displayed in the right field. The top of descent altitude is the point at which the aircraft should begin to descend in order to reach the descent reference waypoint at the required altitude.

NOTE

If no descent reference waypoint with crossing altitude is programmed, the system will use the arrival airport and elevation to fix the TOD as long as an airport is the last waypoint on the active flight plan.

(c) EST CROSSING. The estimated crossing altitude (EST CROSSING) is the altitude at which the aircraft is estimated to be when it crosses the to waypoint based on its current groundspeed and vertical speed. This field will display RANGE (NM) in miles and tenths of a mile when the vertical to waypoint is a #TOD or #TOC profile point.

(d) ETE. The estimated time en route (ETE) from the aircraft's present position to the vertical to waypoint, #TOC, or #TOD is displayed in this field in hours, minutes, and tenths of a minute.

(e) REQUIRED FPM. REQUIRED FPM (required feet per minute) is the vertical speed, required to satisfy the altitude constraint UP indicates a positive vertical speed and DN indicates a negative vertical speed. This field will display @#TOD FPM DN when the vertical to waypoint is the top of descent and indicate the descent target vertical speed.

(f) ACTUAL FPM. This line displays the actual vertical speed in feet per minute. UP indicates a positive vertical speed and DN indicates a negative vertical speed.

(g) VERT DEV. Vertical deviation of the aircraft's flight path from the computed correct descent path in feet. HIGH indicates that aircraft is above path. LOW indicates that aircraft is below path. CLIMB GRAD xxx / NM (climb gradient xxx per nautical mile) is displayed during CLIMB mode to indicate current aircraft climb performance in feet per nautical mile.

NOTE

VERT DEV data field will display dashes if the ETE to descent path intercept is greater than one minute. This line will be blank if no Flight Path Angle (FPA) is programmed at the descent reference waypoint In this case #TOD will be determined using the default FPA from the VNAV Data page.

(h) DATA. Placing the cursor over the DATA field and pressing enter will cause the VNAV Data page to be displayed.

(2) VNAV 2/3 (Flight Plan) Page. Refer to Figure 3A-34.

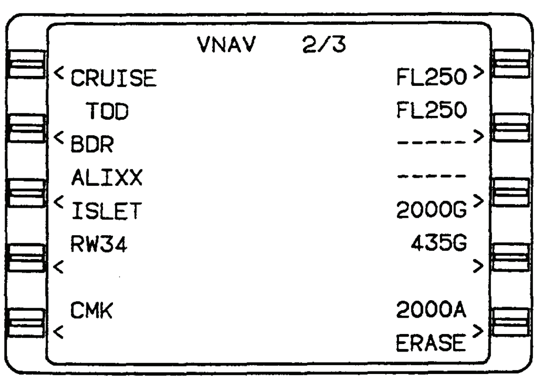


Figure 3A-34. VNAV 2/3 Page

(a) VNAV Mode (First Line Of Display Below Title). This line displays the same information as on VNAV 1/3 page.

(b) Waypoints. Lateral and vertical waypoints are listed on this page in order of occurrence with respect to the vertical profile, with constraint altitude and applicable waypoint offset. One of the following system generated VNAV profile point may also appear.

<u>1</u> *#TOC* – Indicates top of climb target cruise altitude.

<u>2</u> #TOD – Indicates top of descent target cruise altitude.

<u>3</u> *#PRESL* – Indicates the estimated position where the aircraft will arrive at the altitude shown on the altitude pre-selector.

(c) **++++++** – Separates the missed approach procedure from the rest of the approach.

(d) Waypoint Identifiers – May consist of from one to six alphanumeric characters. If more identifiers are present than can be listed on this page, VNAV 3/3, will list the remainder. Refer to Figure 3A-35.

NOTE

Waypoints cannot be added to the active flight plan via VNAV 2*/3.* Enter new waypoint on Active Flight Plan page.

(e) ERASE – Used to erase all altitude constraints, except the altitude constraint at the current lateral TO waypoint.

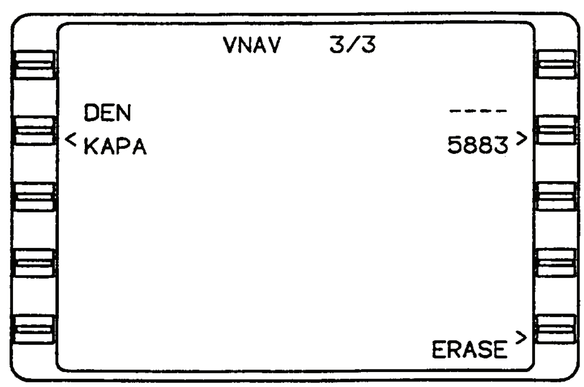


Figure 3A-35. VNAV 3/3 Page

h. VNAV Data 1/1 Page. Refer to Figure 3A-36.

NOTE

This page is accessed by using the line select key to place the cursor over the DATA prompt on one of the VNAV pages and pressing the ENTER key.

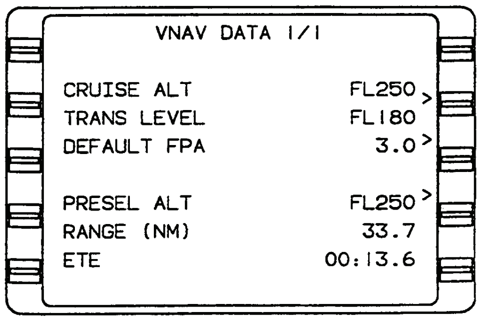


Figure 3A-36. VNAV Data 1/1 Page

(1) CRUISE ALT – This line displays the manually entered cruise altitude in feet or flight level (FL). Any altitude that is greater than the transition level is converted to and displayed as flight level (rounded off to the nearest hundred feet). An altitude less than 1000 feet must be entered with a preceding zero.

NOTE

In a climb, when the aircraft is within 200 feet of the pre-selected altitude, the CRUISE ALT changes to the same value as the PRESEL ALT.

The field also changes to dashes during a descent when the aircraft is 200 feet lower than the CRUISE ALT and the pre-selected altitude is set to a lower value. Then, when the aircraft is within 200 feet of the PRESEL ALT, the CRUISE ALT changes again to the same value as the PRESEL ALT.

(2) Transition Level. The transition level (TRANS LEVEL) field is used to enter the altitude at which the system will convert altitudes to flight level. The field defaults to FL 180 if the pilot does not enter a value.

(3) DEFAULT FPA. This field displays the manually entered descent default flight path angle (DEFAULT FPA) in degrees and tenths of a degree from 0.1° to 6.0°.

NOTE

Enter whole numbers only. The decimal point is entered by the system.

(4) PRESEL ALT. This field displays pre-selected altitude (PRESEL ALT) inputs from the system in feet or flight level.

(5) RANGE (NM). This field displays range to pre-selected altitude in nautical miles and tenths of a nautical mile.

(6) ETE. This field displays the estimated time en route (ETE) to the pre-selected altitude in hours, minutes, and tenths of a minute.

i. VNAV Waypoint 1/1 Page. Refer to Figure 3A-37.

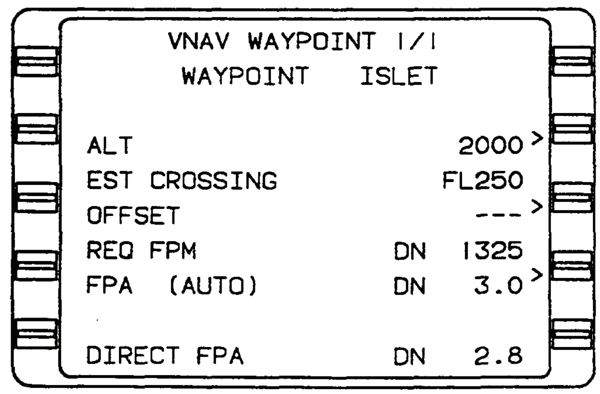


Figure 3A-37. VNAV Waypoint 1/1 Page

(1) WAYPOINT. This field displays the VNAV waypoint identifier, which may consist of from one to six alphanumeric characters.

(2) ALT. This field displays the constraint altitude that pre-fills from the database or can be manually entered. Any altitude entered that is greater than the transition level (from the VNAV Data page) is converted to and displayed as flight level (rounded off to the nearest hundred feet). An altitude less than 1000 feet must be entered with a preceding zero. Altitudes below sea level are limited to -1000 feet. The following may appear in the altitude field.

FL = flight level

A = at or above

B = below

Blank space = at

NOTE

If the destination airport or runway is manually entered, or if the airport/runway is loaded from the database, the airport elevation will be displayed in the altitude field. If the flight plan is loaded through AFIS, the airport elevation will not be available.

(3) EST CROSSING. The estimated crossing altitude (EST CROSSING) is the altitude at which the aircraft is estimated to be when it crosses the TO waypoint based on its current groundspeed and vertical speed (displayed for the active vertical waypoint).

(4) PLAN CROSSING. PLAN CROSSING is system determined crossing based on programmed constraints and flight path angles for descent. Displayed for other than active vertical waypoint.

(5) OFFSET. OFFSET displays pilot value in nautical miles (-99 to +99 range) where a positive entry (+) indicates an offset beyond the waypoint and a negative (-) entry is prior to the waypoint.

NOTE

Pilot must enter the leading (+) sign for the offset to be beyond the fix, but a (–) pre-fills as a default to cross prior to the fix.

(6) REQ FPM. Required feet per minute (REQ FPM) displays the required vertical speed in feet per minute that the aircraft must maintain to reach the vertical waypoint. UP indicates a positive vertical speed and DN indicates a negative vertical speed is required.

NOTE

If PLAN CROSSING is displayed, the REQ FPM is the planned vertical speed for the waypoint.

(7) FPA. FPA displays the flight path angle for path descent to waypoint in degrees and hundredths of a degree with a valid range of 0.1 to 6. The following may appear in parentheses.

(a) DB. Displays FPA from Database (DB).

(b) MAN. Displays manually entered FPA.

(c) DIR. Indicates that a direct (DIR) flight path angle has been programmed.

(d) AUTO. Automatic (AUTO) indicates a system computed FPA.

(e) DEF. Indicates that flight path angle is a default (DEF) from the VNAV Data page.

NOTE

DIR, AUTO, and DEF can be accessed using the BACK key.

(8) DIRECT FPA. Displays the direct flight path angle (DIRECT FPA) from the current aircraft altitude to the vertical waypoint in degrees and tenths of a degree (valid range 0.0 to 90.0). DN indicates a negative FPA and UP indicates a positive FPA.

j. Planning Pages (PLAN Key).

(1) Plan 1/5 Page, Fuel Status. Refer to Figure 3A-38.

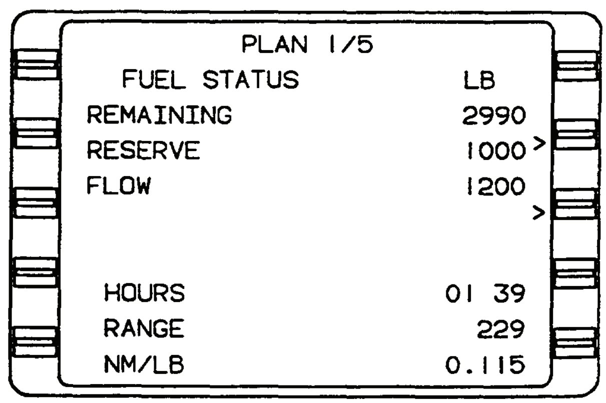


Figure 3A-38. Plan 1/5 Page, Fuel Status

(a) FUEL STATUS LB. This display indicates that fuel data is being computed in pounds. This unit can be manually changed to kilograms (KG), if desired, by using the **BACK** key.

(b) REMAINING. This display shows the total fuel remaining on board in pounds or kilograms. This quantity must be initially entered or verified by the pilot and may require periodic verification or update.

(c) RESERVE. This display shows the desired reserve in pounds or kilograms. This quantity may require periodic verification or update.

(d) FLOW. This display shows the current fuel flow in pounds or kilograms. Fuel flow data is input automatically from the fuel flow

transmitters. MAN indicates that fuel flow data has been manually entered by the pilot and that the entry must be manually verified and periodically updated.

(e) LAST INPUT. This display shows the time in hours and minutes since the above three quantities were verified. This field appears if fuel flow is input manually.

NOTE

This field displays VERIFY INPUTS at system turn-on since REMAINING and RESERVE are stored in nonvolatile memory during system shutdown.

(f) HOURS. This field displays the hours and minutes of fuel remaining until the reserve fuel quantity is reached.

(g) RANGE. This field displays the nautical mile range available until the reserve fuel quantity is reached.

(h) NM/LB. This field displays the number of nautical miles flown for each pound or kilogram of fuel consumed.

(2) Plan 2/5 Page, Trip Plan. Refer to Figure 3A-39.

(a) TRIP PLAN. This field displays the selected flight plan by an A for active flight plan or a number (1 to 56) for a stored flight plan.

(b) FR. The from (FR) waypoint identifier is followed on the same line by the first waypoint (origin) on the selected flight plan. The FR waypoint may be replaced by DIRECT.

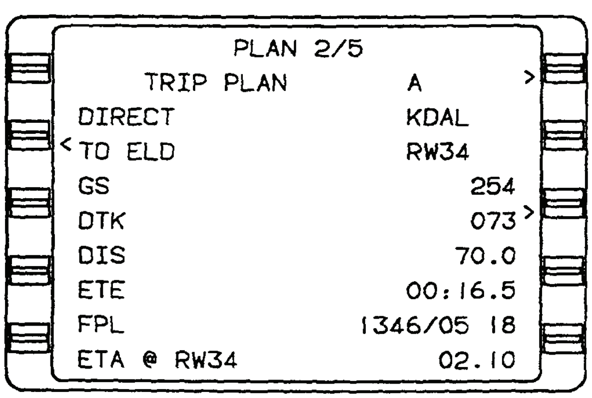


Figure 3A-39. Plan 2/5 Page, Trip Plan

(c) TO. The TO waypoint identifier is followed on the same line by the last waypoint (destination) on the selected flight plan.

(d) GS. Groundspeed (GS) in knots is input automatically when the groundspeed is valid or can be inserted manually, which is indicated by MAN. Calculated (CALC) is displayed if a manual ETA is entered.

(e) DTK. Desired track (DTK) is the great circle course between the FR and TO waypoints based on the GS.

(f) DIS. Distance (DIS) in nautical miles and tenths of a nautical mile between the FR and TO waypoints based on the GS.

(g) ETE. This display shows the estimated time en route (ETE) in hours, minutes, and tenths of a minute between waypoints on the active flight plan based on current groundspeed.

(h) FPL. This display shows the total distance and time remaining from the FR waypoint or the present position, when a DIRECT TO leg is displayed, to the last waypoint on the selected flight plan via the flight planned route. Distance is displayed in miles and time is in hours and minutes.

(i) ETA@. This display shows the ETA at the destination, or last waypoint on the active flight plan that provides a "fence." Appears when a DIRECT TO leg is displayed.

NOTE

The ETA field will flash if the ETA is behind the current time.

(j) RAIM@. Receiver autonomous integrity monitoring (RAIM) at the specified point will either be available (AVAIL) or not available (NOT AVAIL) at the ETA. If a manual groundspeed has been entered, STANDBY will be displayed. If GPS is not functioning, NO NAV will be displayed.

(3) Plan 3/5 Page, Fuel Plan. Refer to Figure 3A-40.

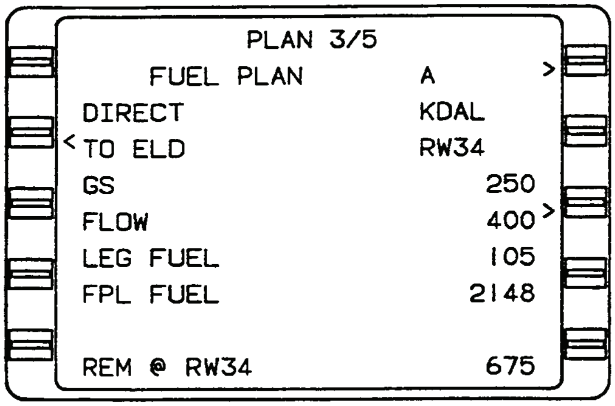


Figure 3A-40. Plan 3/5 Page, Fuel Plan

(a) FUEL PLAN. An **A** in this display indicates that active flight plan information is being displayed. A numeric entry in this field provides fuel planning for stored flight plans.

(b) FR. This line displays the FROM waypoint identifier followed on the same line by the first waypoint (origin) on the selected flight plan. The FR waypoint may be replaced by DIRECT.

(c) TO. This line displays the TO waypoint identifier followed on the same line by the last waypoint (destination) on the selected flight plan.

(d) GS. This line displays the GS in knots which is input automatically when the groundspeed is valid or can be input manually, which is indicated by MAN.

(e) FLOW. This line displays fuel flow in pounds or kilograms per hour that is input automatically from fuel flow transmitters or can be inserted manually, which is indicated by MAN.

(f) LEG FUEL. This line displays the quantity of fuel which will be used on the current FROM/TO leg or from the aircraft's present position to the current TO waypoint, based on groundspeed, fuel flow, and distance.

(g) FPL FUEL. This line displays the total quantity of fuel projected to be consumed in the total flight plan. This calculated value is based on the current fuel flow and groundspeed.

(h) REM@. This line only appears if a DIRECT TO leg is displayed. It indicates the amount of fuel remaining overhead at destination, or the last waypoint on the flight that precedes a "fence", under current conditions. This value is based on the REMAINING fuel quantity from the Fuel Status page minus the total FPL fuel.

(4) Plan 4/5 Page, Date/GMT. Refer to Figure 3A-41.

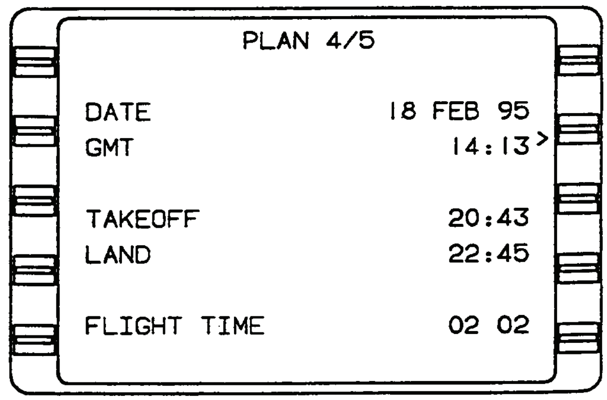


Figure 3A-41. Plan 4/5 Page, Date/GMT

(a) DATE. This line displays the current Greenwich date (day, month, and year). When the date is entered, the numerals 01 through 12 are entered for the months. The computer changes this month designation to its alpha equivalent.

(b) GMT. This line displays the time of day in GMT in hours and minutes. GMT may be updated to GPS time by placing the cursor over the GMT data field and pressing the **BACK** key. If GPS time is available, GPS? appears under the cursor. Press **ENTER** key to update GMT to GPS time.

NOTE

If necessary, both DATE and GMT can be corrected on this page.

(c) TAKEOFF. The TAKEOFF field displays the GMT at weight off wheels time.

(d) LAND. The LAND field displays the GMT at weight on wheels time. This field will not appear until weight on wheels occurs.

(e) FLIGHT TIME. This field displays elapsed flight time in hours and minutes.

(5) Plan 5/5 Page, Aircraft Weight. Refer to Figure 3A-42.

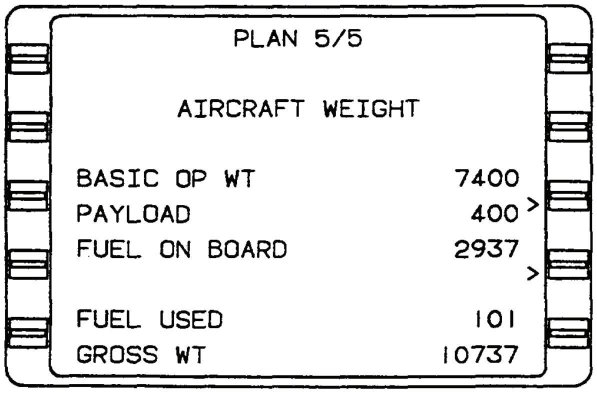


Figure 3A-42. Plan 5/5 Page, Aircraft Weight

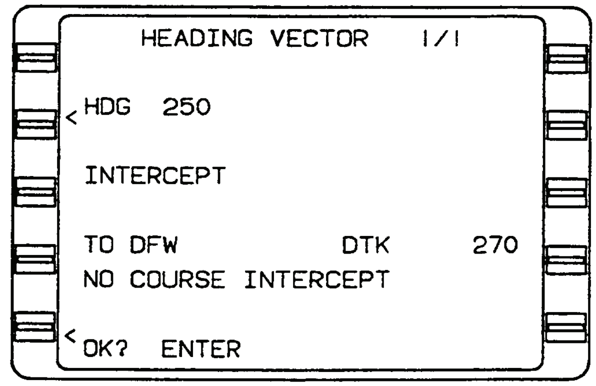


Figure 3A-43. Heading Vector 1/1 Page

(a) BASIC OP WT. The basic operating weight (BASIC OP WT) field displays the combined weight in pounds or kilograms of the empty aircraft, crew members, and crew baggage.

(b) PAYLOAD. The PAYLOAD field displays the weight in pounds or kilograms of passengers, cargo, and baggage.

(c) FUEL ON BOARD. The FUEL ON BOARD field displays the weight in pounds or kilograms of fuel on board.

(d) VERIFY INPUTS. Each of the flashing values must be verified by pressing the **ENTER** key when the cursor is over a field.

NOTE

This field can also display VERIFY FUEL.

(e) FUEL USED. Displays the weight in pounds or kilograms of fuel consumed.

NOTE

This field appears as dashes at power up and increments as auto fuel flow data is available.

(6) GROSS WT. This field displays the total weight in pounds or kilograms of basic operating weight, payload, and fuel onboard.

k. Heading Section.

(1) Heading Vector 1/1 Page. Refer to Figure 3A-43.

(a) HDG. This line displays the commanded heading in degrees. This field may also pre-fill with current aircraft heading if heading mode is not active. The pilot may manually enter heading preceded by a turn direction (R or L). A T indicates that the system is operating in the true heading mode.

(b) HEADING MODE. The **BACK** key may be used to select one of the following.

<u>1</u> *HDG SELECT.* Heading select displayed on this line indicates that heading mode is on, but system has not intercepted.

<u>2</u> *INTERCEPT.* INTERCEPT displayed on this line indicates that heading mode is on and the system will intercept the next leg.

<u>3</u> *CANCEL.* CANCEL displayed on this line indicates that heading mode is off.

(c) TO. This line pre-fills with current TO waypoint identifier or is enterable (from one to six alphanumeric characters).

NOTE

With the cursor over the TO waypoint field, using the BACK key will step through the active flight plan waypoints.

(d) DTK. This field displays Desired Track (DTK) in degrees. Desired track is the great circle route between the FROM and TO waypoints.

NOTE

If the default desired track is changed, a pseudo VORTAC leg will be programmed.

(e) INTERCEPT MESSAGES. If the intercept mode is programmed, one of the following messages may appear.

1 *INTERCEPT BEYOND FIX.* The intercept message INTERCEPT BEYOND FIX indicates that the commanded heading will not cause the aircraft to intercept the programmed course on the TO side of the fix.

2 *NO COURSE INTERCEPT.* The intercept message NO COURSE INTERCEPT indicates that the commanded heading will cause the aircraft to diverge from the programmed course (crosstrack deviation will increase).

3 *NO Message.* No message indicates either that there is no TO waypoint, an intercept is not programmed, or that the commanded heading will not intercept the programmed course prior to the fix.

(f) OK? ENTER. The OK? ENTER prompt at the bottom of the screen indicates that the procedure for accepting the entered TO waypoint or DTK is to press the **ENTER** key.

I. Tuning Section (Tune Key).

(1) Tune 1/4 Page, Comm. Refer to Figure 3A-44.

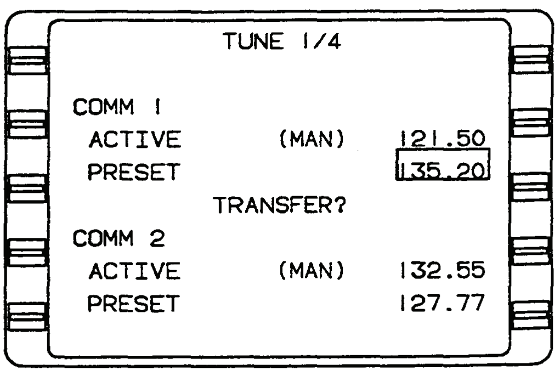


Figure 3A-44. Tune 1/4 Page (COMM)

(a) COMM 1 or COMM 2. The information displayed on the lines below this heading applies to COMM 1 or COMM 2.

(b) ACTIVE. This field displays the frequency currently tuned and displayed on the respective control head. This display will appear briefly but will turn to dashes because the system interface does not provide a return frequency input. MAN in this field indicates that the frequency was manually entered via the control unit.

(c) PRESET. The pilot can enter and store a frequency in this field using the flight management system keyboard.

(d) TRANSFER?. This display indicates that the displayed preset frequency can be transferred to ACTIVE when the **ENTER** key is pressed. The control unit will reflect this change.

(2) Tune 2/4 Page, Comm. This page displays the same information as the first page for additional COMM radios.

(3) Tune 3/4 Page, Nav. Refer to Figure 3A-45.

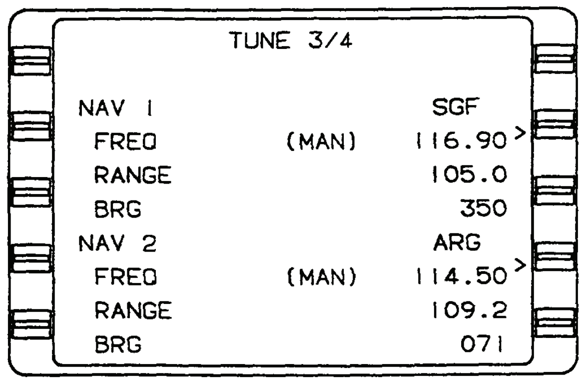


Figure 3A-45. Tune 3/4 Page, Nav

(a) NAV 1 or NAV 2 – The station identifier to which the respective NAV receiver is tuned. KEY will be displayed when the frequency or identifier of the station has been entered using the keyboard.

(b) FREQ. This line displays the frequency currently tuned and displayed on the respective control unit. MAN in this field indicates that the frequency was manually entered via the control head. This field may also show KEY if the identifier is unknown.

(c) RANGE. This field displays the range in nautical miles and tenths of a nautical mile from the aircraft's present position to the DME station. The station identifier can also appear in this field if the control unit is placed in the DME HOLD mode. NO ID will be displayed if the identifier of the held station is unknown.

(d) BRG. This field displays the bearing in whole degrees.

(4) Tune 4/4 Page, XPDR / ADF. Refer to Figure 3A-46.

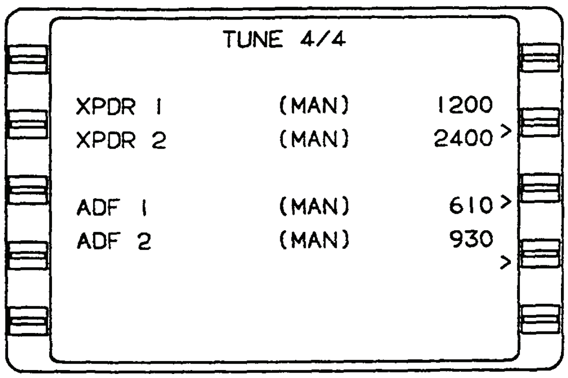


Figure 3A-46. Tune 4/4 Page, XPDR/ADF

(a) XPDR. This field displays the transponder (XPDR) reply code. The transponder reply code will appear briefly but will turn to dashes because the system interface does not provide a return frequency input. MAN indicates the entry was made through the control unit.

NOTE

If either the XPDR or ADF frequencies are tuned via the keyboard, MAN will not appear.

(b) ADF. This field displays the Automatic Direction Finder (ADF) frequency. The ADF frequency will appear briefly but will turn to dashes because the system interface does not provide a return frequency input. MAN indicates the entry was made through the control unit.

m. Holding Pattern Section (HOLD Key).

(1) Holding Pattern 1/1 Page. Refer to Figure 3A-47. This page is accessed by pressing the **HOLD** key when the cursor is positioned over a waypoint identifier.

(a) AT. This line displays the holding fix and country name or airport ident.

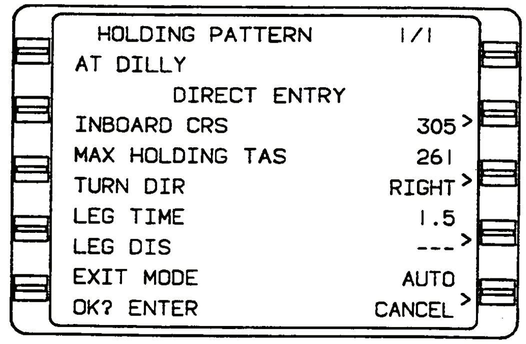


Figure 3A-47. Holding Pattern 1/1 Page

(b) Holding Pattern Entry And Status Message. If the entry course to the holding fix can be determined, the entry procedure will be annunciated after all the holding pattern parameters are entered.

<u>1</u> *DIRECT ENTRY*. This indicates that the system will use a direct entry to the holding pattern.

<u>2</u> *TEARDROP ENTRY*. This indicates that the system will use a teardrop entry to the holding pattern.

<u>3</u> *PARALLEL ENTRY* – Indicates that the system will use a parallel entry to the holding pattern.

<u>4</u> *HOLDING* – Indicates that the system has entered the holding pattern.

<u>5</u> *EXIT HOLD* – Indicates that the system will exit the holding pattern the next time over the holding fix.

(c) INBOUND CRS. This field displays the inbound course (INBOUND CRS) in degrees. This field can be indexed to true north or magnetic north depending upon the display mode selected by the TRUE/MAG switch input. A T appears if the system is in the true mode.

(d) MAX HOLDING TAS. The maximum holding true airspeed field (MAX HOLDING TAS) is computed based on configuration module maximum holding indicated airspeed and worst case winds. It represents the maximum true airspeed in the holding pattern that will assure that the aircraft remains in protected airspace.

(e) TURN DIR. The turn direction (TURN DIR) field indicates the direction of turns in the holding pattern. RIGHT displayed in this field indicates

standard holding pattern turn direction. Non-standard (LEFT) turn direction can be entered by using the **BACK** key.

(f) LEG TIME. This field indicates the holding pattern inbound leg time in minutes and tenths of a minute.

NOTE

Leg time defaults to an appropriate value based on altitude and may appear in parentheses if it has been computed from the LEG DIST.

(g) LEG DIS. The leg distance (LEG DIS) field displays holding pattern inbound leg distance in nautical miles (1.0 to 50.0 nautical miles).

NOTE

When LEG DIS is computed by the system based on LEG TIME, the field is in parentheses.

(h) EXIT MODE. Manual (Default Mode) displayed in this field indicates that the system will remain in the holding pattern indefinitely. The **BACK** key may be used to select AUTO. This allows the flight crew to program or execute a procedure turn for course reversal. The system will then execute a holding pattern entry and exit after crossing the fix waypoint.

NOTE

If MANUAL is selected, an HP will be annunciated next to the waypoint on the Flight Plan, Navigation, and Direct To pages. If AUTO is selected a PT will be annunciated next to the waypoint on Flight Plan, Navigation, and Direct To pages.

(i) OK? ENTER. When the OK? ENTER prompt is displayed at the bottom of the holding pattern page, pressing the **ENTER** key will program a holding pattern for a particular waypoint.

NOTE

The cursor will not appear on this field.

(j) CANCEL. Used to cancel a holding pattern.

(2) Position Fix Page. The Position Fix page is accessed by pressing the **HOLD** key while the cursor is off the page. Refer to Figure 3A-48.

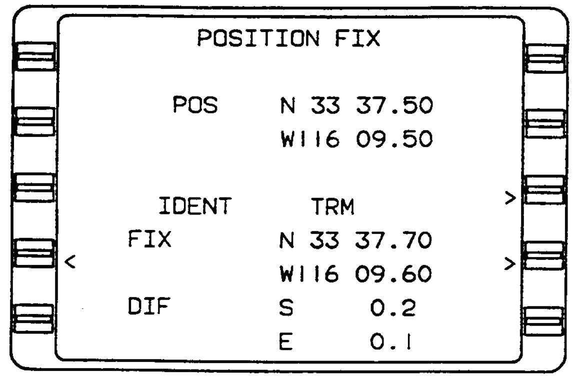


Figure 3A-48. Position Fix Page

(a) POS. This field displays the composite (system) position coordinates at the moment the **HOLD** key was pressed in degrees, minutes, and hundredths of a minute.

(b) IDENT. The IDENT field displays the alphanumeric designator of the reference point that is used to check or update position.

(c) FIX. This field displays the actual coordinates of the reference in degrees, minutes, and hundredths of a minute.

NOTE

Position coordinates of individual sensors and the difference between those sensor positions and the composite (system) position may be displayed by moving the cursor over the FIX field and pressing the BACK key.

(d) DIF. This field displays the difference between the composite position and the FIX (or other sensor) position in degrees, minutes, and hundredths of a minute.

n. Direct To Section.

(1) Direct 1/2 Page. The Direct 1/2 page is accessed by pressing the D► key and presents a listing of all active flight plan waypoints. The cursor may be positioned over any desired identifier (ahead of or behind the aircraft) to proceed DIRECT. Refer to Figure 3A-49.

(a) TO. When the Direct 1/2 page is accessed, the cursor will be displayed over the current TO waypoint on the active flight plan.

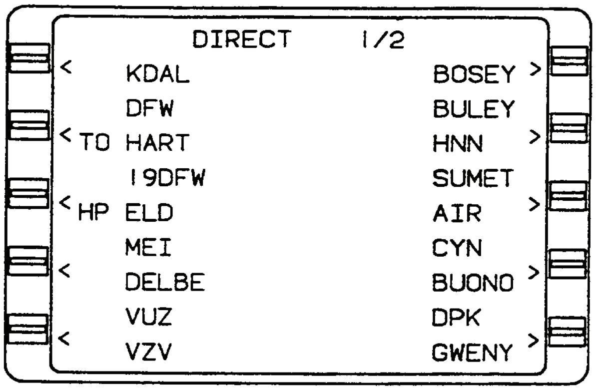


Figure 3A-49. Direct To 1/2 Page

(b) HP. HP (holding pattern) indicates that a holding pattern is programmed at a particular waypoint.

(c) PT. PT (procedure turn) indicates that a procedure turn is programmed at a particular waypoint.

(2) Dir 2/2 Page, Closest Airport. The direct to closest airport, DIR Closest ARP, page displays up to nine airports in order of their proximity to the aircraft, with the closest airport listed first. Refer to Figure 3A-50.

NOTE

Airports listed from the database have hard surfaced runways of 3,000 feet or longer.

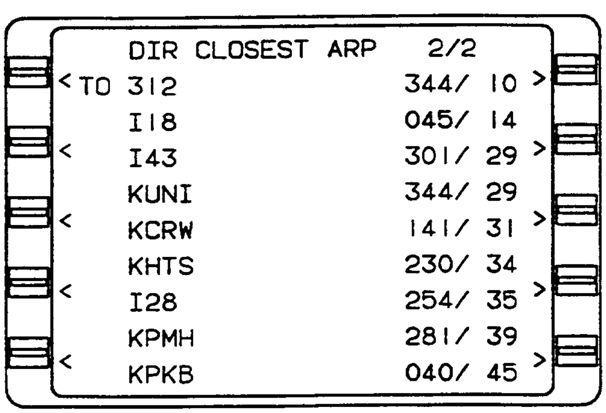


Figure 3A-50. Direct To 2/2 Page, Closest Airport

o. Waypoint Pages. Waypoint pages can be accessed from any Flight Plan, Nav Direct, Hold, Initialization, Heading, or Trip Plan/Fuel Plan pages. There are four categories of waypoints: database generated, pilot entered (personalized/offset), special, and obsolete.

(1) Database WPT 1/8 Page. Refer to Figure 3A-51, Sheets 1 through 8. Database generated waypoints are automatically updated when accessed and cannot be modified by the operator. The three basic types of waypoints residing in the database are navaids, airports, and intersections.

(a) VHF Navaids.

<u>1</u> *WAYPOINT.* This field displays the alphanumeric designator for the navaid.

<u>2</u> *POS.* This field displays the coordinates of the waypoint position (POS) as stored in the database.

<u>3</u> *FREQ.* This field displays the frequency (FREQ) for the station.

<u>4</u> *VAR.* This field displays the magnetic variation (VAR) of the station location.

<u>5</u> *ELEV.* This field displays the elevation in feet of the station (DME equipped VHF navaids only). A minus sign (–) indicates that the elevation of the station is below sea level.

<u>6</u> *NDB-ENTER.* To accept the waypoint from the navigation database (NDB), press the **ENTER** key.

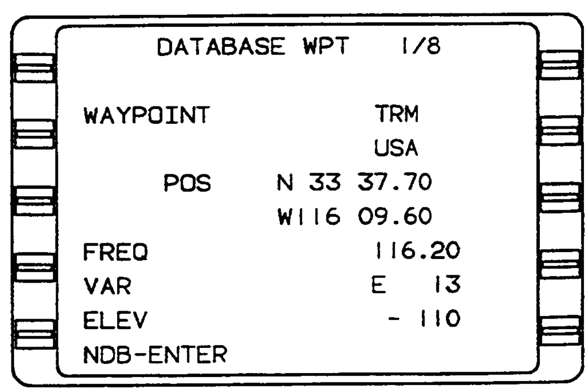


Figure 3A-51. Database Waypoint 1/8 Page (Sheet 1 of 8)

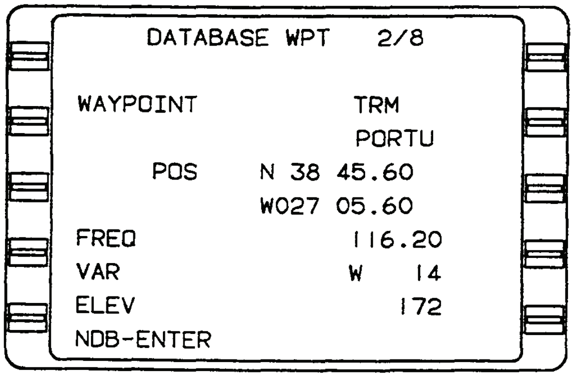


Figure 3A-51. Database Waypoint 2/8 Page (Sheet 2 of 8)

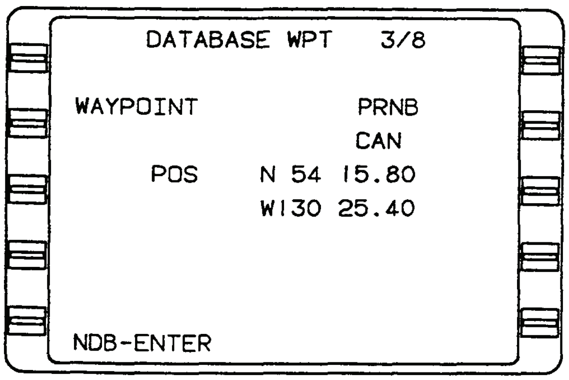


Figure 3A-51. Database Waypoint 3/8 Page (Sheet 3 of 8)

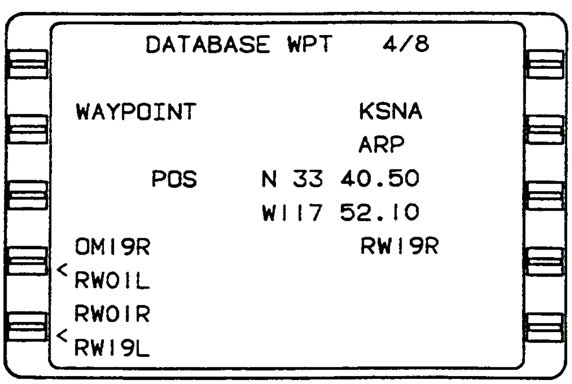


Figure 3A-51. Database Waypoint 4/8 Page (Sheet 4 of 8)

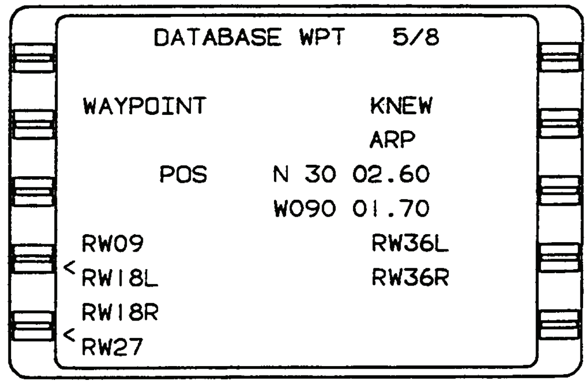


Figure 3A-51. Database Waypoint 5/8 Page (Sheet 5 of 8)

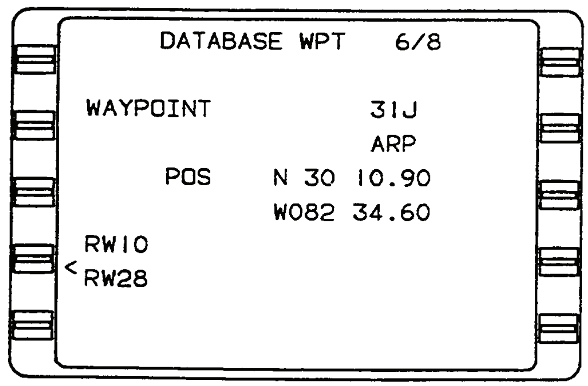


Figure 3A-51. Database Waypoint 6/8 Page (Sheet 6 of 8)

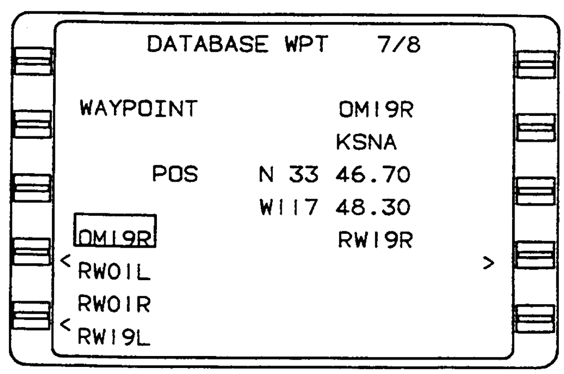


Figure 3A-51. Database Waypoint 7/8 Page (Sheet 7 of 8)

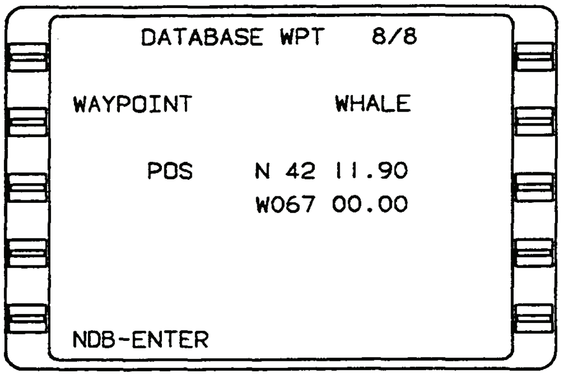


Figure 3A-51. Database Waypoint 8/8 Page (Sheet 8 of 8)

NOTE

If the waypoint has a duplicate identifier in the database for another location, the closest waypoint to the aircraft's position will be shown and the country code will be displayed beneath the waypoint identifier.

Press the NXT key to sequence to the next waypoint page with a different country code. The PRV key can be used to sequence backward through the waypoint pages. Additional country codes and corresponding POS coordinates will be sequentially displayed.

(b) Non-Directional Beacons (NDB). NDB that are stored in the internal database are listed with a two or three letter identifier. To distinguish these NDB from VHF navaids, you must add an NB suffix to the database identifier.

(c) Airports. International Civil Aviation Organization (ICAO) identifiers are used to access data in the database. Except for a few hundred three or four character airport identifiers in Alaska, Canada, and the continental United States, all airport identifiers are in the database. In most cases an ICAO country code letter prefix is the first character of the identifier.

To access a four character identifier, use the identifier found in navigation charts.

If the airport is shown in the navigation charts as a three letter identifier, add the correct prefix letter.

If the airport is shown in the navigation charts as a three character (letters and numbers) identifier, enter the identifier as printed.

(d) Airport Reference Points, Outer Markers, And Runway Thresholds. Airport Reference Point (ARP) coordinates are always displayed in response to the airport identifier. Outer markers and runway thresholds for which data is stored in the database are also displayed on the airport waypoint page and can be accessed by pressing the **PRV** or **NXT** key or line select keys. The selected outer marker or runway threshold will then be displayed on the page of origin in the waypoint field with the airport identifier immediately below.

(e) Intersections/En Route Waypoints. Most waypoint identifiers consist of five letters; however, three, four, and five letter and number combinations exist. To access these waypoints, simply enter the identifier from the navigation charts.

(2) Pilot Entered Waypoint Page. The pilot entered waypoint page allows the pilot to enter custom waypoints. Refer to Figure 3A-52.

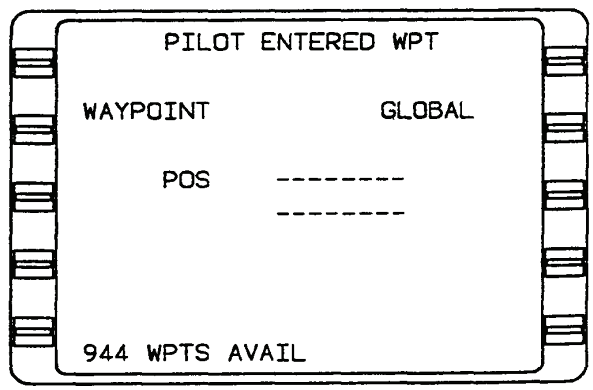


Figure 3A-52. Pilot Entered Waypoint Page

(a) WAYPOINT. The alphanumeric designator selected by the pilot to name custom waypoints. Identifiers can consist of up to six characters, and can be composed of any of the characters on the keyboard except the asterisk (*) and pound sign (#).

(b) POS. These are blank fields for entering the latitude and longitude of the waypoint. When initially accessed (waypoint not yet in memory) the coordinate fields are both dashed and covered by a double cursor.

(c) WPTS AVAILABLE. The waypoints (WPTS) available field displays the number of waypoints available in memory after this waypoint has been defined. Maximum waypoint storage in non-volatile memory is 999.

(d) OK? ENTER. If the coordinates are correct, press the **ENTER** key to accept the waypoint.

(3) Offset Waypoint 1/1 Page. Refer to Figure 3A-53. An offset waypoint is a set of coordinates determined by a selected radial and distance from a previously defined or database waypoint, called a parent waypoint. An (*) following the parent waypoint denotes an offset waypoint. More than one offset waypoint is allowed from one parent, using {***[**,{***1[**, {***A1[**, etc., as identifying notation.

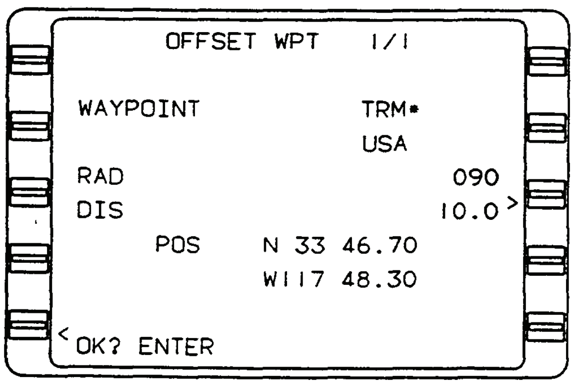


Figure 3A-53. Offset Waypoint 1/1 Page

NOTE

The offset waypoint uses station declination, if available, or it uses the calculated magnetic variation of the parent waypoint. All points defined by a VHF navaid in the national/international airspace system are based on the VHF navaid station declination. Since the magnetic variation and station declination may not be the same at a given navaid, the calculated position and the defined position may differ.

(a) WAYPOINT. The WAYPOINT field displays the parent waypoint identifier followed by an *. When an offset waypoint identifier is entered and the waypoint has not been previously defined, the RAD, DIS, and POS fields are all dashed. When the waypoint has been previously defined, the coordinates will be displayed and the radial and distance values will be computed based on the location of the parent waypoint. If the parent waypoint is an airport continuation record, the airport identifier will be displayed immediately below the offset waypoint identifier. If a parent waypoint has a duplicate identifier in the database, the country code will be displayed immediately below the offset waypoint identifier.

(b) RAD. The radial (RAD) field displays the radial from the parent waypoint along which the offset is established. This entry will be annunciated with a T if a true heading input is received or if the parent waypoint is above N 70°or S 60° latitude.

(c) DIS. This field displays the distance in nautical miles from the parent waypoint to the offset waypoint (399.9 nm maximum).

(d) POS. This field displays the computed offset waypoint coordinates based on the pilot entered radial and distance from the parent waypoint.

(e) OK? ENTER. If the waypoint coordinates are correct, press the **ENTER** key.

(4) Special Waypoint. Refer to Figure 3A-54. The special waypoints #1 and #OFF are defined automatically by the system based on aircraft position.

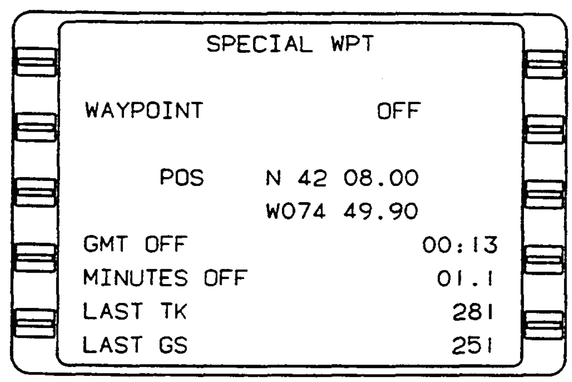


Figure 3A-54. Special Waypoint Page

(a) #1. Special waypoint *#1* is the position at which the POSITION FIX page was last accessed. Special waypoint #1 can only be defined by the system.

(b) Power Off Waypoint. The power off waypoint is a set of coordinates retrieved as the last known position when power is lost en route. This page should be accessed by inserting #OFF into the IDENT field on the POSITION FIX page after power has been restored and initialization en route has been performed.

<u>1</u> *WAYPOINT #OFF* – This is the power off waypoint designator.

2 *POS* – This field displays the last present position coordinates at loss of power. These coordinates are stored in non-volatile memory.

3 *GMT OFF* – This field displays the actual GMT of power loss.

4 *MINUTES OFF.* This field displays the total time elapsed during power off.

5 *LAST TK.* This field displays the last aircraft track at time of power off.

6 *LAST GS.* This field displays the last groundspeed at time of power off.

(5) Obsolete Waypoint. Obsolete waypoints are typically created when a multiply defined database waypoint used on a flight plan is no longer found in the database. This may happen when a new database is loaded. An obsolete waypoint can be accessed only by verifying an existing waypoint on a flight plan. It will be lost once its last occurrence on a flight plan is removed.

p. Messages (MSG Key). System and sensor messages are displayed on separate pages in the message section. They are accessed by pressing the **MSG** key. The message section will consist of as many pages as are required to display current messages. The **MSG** key is used to sequence through the system and sensor message pages and to return to the page that was displayed before accessing the message section.

The **NXT**, **BACK**, and **PRV** keys are used to page forward and backward through the message pages. System messages describe the system's operation with all related aircraft systems. Refer to Figure 3A-55. Sensor messages describe the operational status of each navigation sensor. Refer to Figure 3A-56.

When new messages are added, the message light will flash and a flashing asterisk will appear adjacent to the new message.

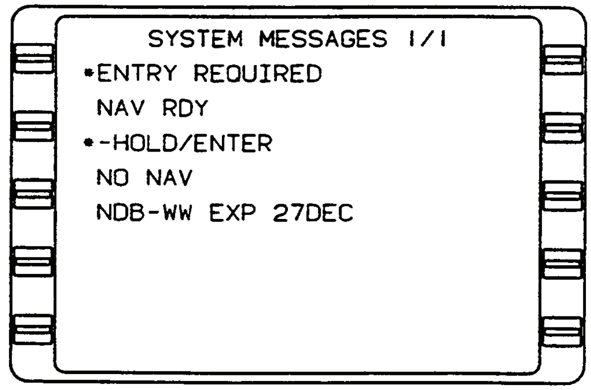


Figure 3A-55. System Messages 1/1 Page

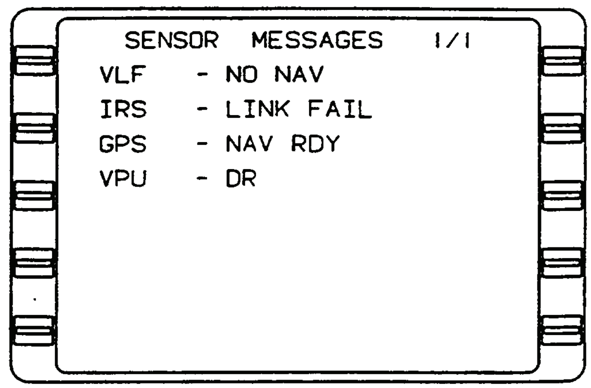


Figure 3A-56. Sensor Messages Page

q. System Operation.

*(1) Power **ON/OFF** and Parallax Adjustment.*

1. **ON** key – Press (briefly). The self-test page will be displayed for approximately 30 seconds. During the time that the SELF-TEST message is displayed, the system is performing internal self-tests. These tests verify the inputs and outputs from the Control Display Unit (CDU) and Receiver Processor Unit (RPU).

NOTE

If the system was turned off last by the removal of aircraft power, the system will turn on automatically when aircraft power is applied.

2. **BRT** key – Adjust as required. The system will initially come on full bright.

– Press and hold the **BRT** key to dim the display. Release the **BRT** key. – Press and hold again to brighten the display.

NOTE

The display may be changed instantaneously to full bright from any brightness level by momentarily pressing the ON key

3. Parallax – If the line select keys do not align with the line select prompts on the CRT, adjust as follows.

   a. Press the **BRT** key. If the screen begins to dim, release the **BRT** key. Press again and hold while momentarily pressing the **D** key, then the **P** key.

   b. Using the **U** (up) or **D** (down) key, adjust the display to the desired alignment.

   c. Press any key when alignment is complete.

4. **ON** key – Press and hold for 3 seconds to turn system off.

(2) Initialization Page. The Initialization page gives the pilot access to the required initialization data (date, GMT, and position). Following confirmation or entry of this data, the page disappears and cannot be retrieved unless system power is removed and then restored. GMT and date are available for display in the PLAN section and position is available in the NAV section.

(a) DATE and GMT.

1. DATE – Insert, if required (day/ month/year digits only).

NOTE

DATE and GMT are continuously updated while the system is off. When the system is turned on, the DATE and GMT will appear on the Initialization page. If the DATE is incorrect, move the cursor to the DATE field to update manually.

Enter a leading 0 for months with a numerical value of less than 10.

2. **ENTER** key – Press to verify display.

3. GMT – Insert if required (hours and minutes).

4. IDENT – Verify position. The appropriate airport ICAO identifier or latitude and longitude may be inserted at this point

NOTE

After a brief delay, this field normally pre-fills with the identifier of the airport closest to the aircraft's present position at power-up, provided the aircraft's real position and system position were the same at system shutdown.

5. **ENTER** key – Press to verify display.

6. **MSG** key – Press to verify database expiration date and to review other system messages. Continue pressing **MSG** key to review sensor messages and to return to Initialization page.

(3) Departure Position. The departure position should be the runway threshold. The departure position may be entered using either the field identifier or the latitude and longitude in the POS field.

(4) Entering Departure Position Using ICAO Identifier Field.

1. Line select key – Press to position cursor over desired field (if required).

2. Desired number and letter keys – Press until desired identifier appears in display.

3. **ENTER** key – Press.

4. Airport Reference Point (ARP) coordinates – Will be displayed with continuation records listed below.

5. Airport continuation records – To access, position the cursor over the departure runway identifier. This will automatically result in the display of the departure runway threshold in the waypoint field, the departure airport will replace the ARP field, and POS

coordinates will reflect selected runway threshold.

6. **ENTER** key – Press.

If AFIS is not installed, the system will automatically advance to the Flight Plan List page. Refer to Figure 3A-57. The cursor will be positioned over the first flight plan number that originates with the same airport or runway identifier as entered on the Initialization page. If AFIS is installed, the system will advance to the AFIS FPL page where a flight plan may be selected from the disc that has been inserted into the AFIS DTU.

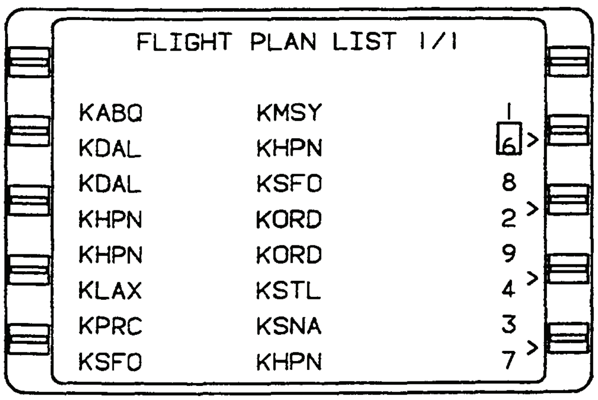


Figure 3A-57. Flight Plan List 1/1 Page

(5) Entering Departure Position Using POS Field.

1. Line select key – Press to position cursor over POS field. Verify position coordinates.

NOTE

Coordinates displayed are the computed position when the system was shut down. If correct, these coordinates may be used as the departure position.

2. Latitude – Insert N or S first, then degrees, minutes.

3. Latitude – Insert N or S first, then degrees, minutes, and tenths of a minute.

4. **ENTER** key – Press.

NOTE

If coordinate field flashes after entry, verify coordinates and press ENTER again. Coordinate field will flash if the entered value varies more than 10 arc minutes from the displayed value. If only one coordinate is in error, it may be updated individually by pressing the N, S, E, or W key to access the desired field.

5. Longitude – Insert E or W first, then degrees, minutes, and tenths of a minute.

6. **ENTER** key – Press.

r. Building Flight Plans (FPL Key).

(1) Creating A Flight Plan. Refer to Figure 3A-58.

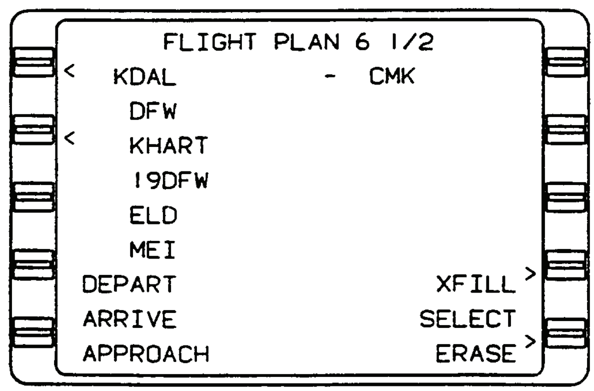


Figure 3A-58. Flight Plan 1/2 Page (Sheet 1 of 2)

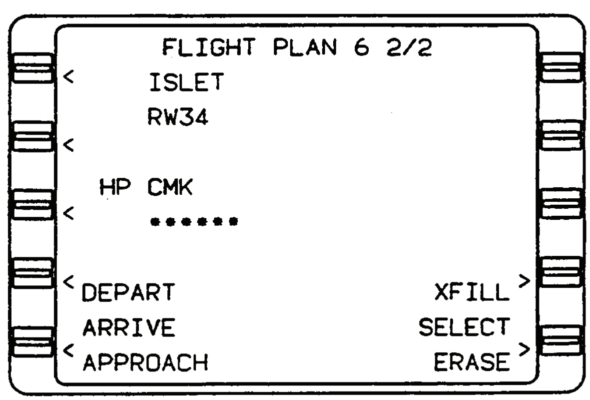


Figure 3A-58. Flight Plan 2/2 Page (Sheet 2 of 2)

1. **FPL** key – Press to display Flight Plan List page.

2. Line select key – Press to position cursor on blank line and display the Next FPL number.

NOTE

If several flight plans are displayed, position cursor on page then press the BACK key to show the next FPL number available. A flight plan may be selected by bringing the cursor onto the flight plan list page and entering the desired number in the cursor.

3. **ENTER** key – Press to display Flight Plan page.

4. Appropriate departure airport identifier – Type into cursor field.

NOTE

Identifier may contain from one to six characters in any combination of letters and numbers.

5. **ENTER** key – Press.

6. Waypoint coordinates and data – Verify. If a specific runway is desired, press the appropriate line select key to place the cursor over the desired runway.

7. **ENTER** key – Press to store waypoint.

8. Next waypoint – Type on flight plan. A Standard Instrument Departure (SID) may be selected at this time by placing the cursor over the DEPART field using the line select key and pressing **ENTER**. A jet or victor airway may also be entered at this time.

9. Repeat steps 7 and 8 for the remaining waypoints.

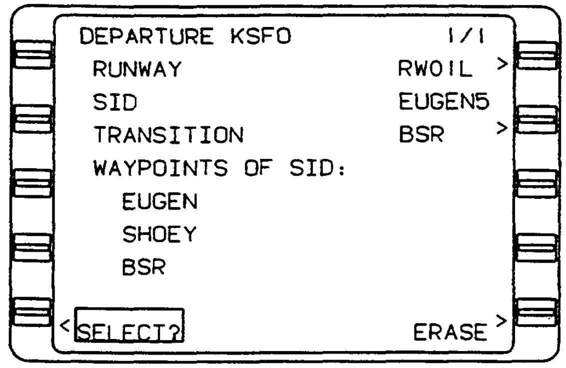


Figure 3A-59. Departure 1/1 Page

NOTE

A maximum of 50 waypoint identifiers can be entered on stored flight plans and 100 on the active flight plan.

Attempting to enter more than the maximum allowed will cause FPL FULL to be displayed with the identifier flashing in the cursor.

Attempting to enter more than 999 pilot entered waypoints in memory causes MEM FULL to be displayed on the Flight Plan page. The MSG light will flash and WPT MEM FULL will be displayed on System Messages page.

If necessary, use the PRV or NXT key to cycle through all available Flight Plan List pages.

If all 56 flight plans are used, NO FPL AVAIL will appear in the field. Any of the stored flight plans may be erased to allow additional entries. The procedure is described under modifying a flight plan.

The flight plan is referenced according to departure and destination pairs and is automatically sequenced in alphabetical order on the Flight Plan List page.

(2) Using Duplicate Waypoint Identifiers. There are several waypoints around the world with the same identifier. If the identifier selected has more than one waypoint associated with it, additional pages will be indicated on line 1 (that is 1/2 etc.). The waypoint nearest the aircraft position will be displayed first.

(a) Selecting an Alternate Waypoint Location.

1. **PRV** or **NXT** key – Press until desired country name is displayed.

2. **ENTER** key – Press to store waypoint.

(3) Reviewing Waypoint Data/Coordinates (Flight Plan Pages only).

(a) Accessing Desired Flight Plan.

NOTE

Flight plans are listed in alphabetical order.

1. **FPL** key – Press to position the cursor over desired flight plan number.

2. Line select key – Press to position the cursor over desired flight plan number.

3. **ENTER** key – Press.

4. Line select key – Press position cursor over identifier to be reviewed.

5. **ENTER** key – Press.

6. Waypoint coordinates – Verify.

7. **ENTER** key – Press. The flight plan is displayed with the cursor over the next waypoint.

8. Repeat steps 2 through 4.

NOTE

This procedure may also be used for reviewing waypoint information on the active flight plan page.

s. SID's, STAR's, Approaches, and Airway. The Standard Instrument Departure (SID), Standard Terminal Arrival Route (STAR), approach, and airway retrieval features are designed to relieve flight crew workload. SID's and STAR's require such procedures as flying headings and altitudes, as well as intercepting VOR radials and DME arcs, etc. Approaches are flown waypoint to waypoint until the missed approach point. Missed approach procedures must then be flown manually. The FMS is only designed to provide meaningful input to the HSI when a track between two waypoints or when pseudo VORTAC procedures are used. The system is not designed to fly full SID or STAR procedures.

When flying those portions of a SID or STAR that are not tracks between fixes, the aircraft should be flown manually or in HEADING mode. In some cases, pseudo VORTAC procedures can be used to establish an intercept to a published track. When using the pseudo VORTAC mode, or upon intercepting a published track between two waypoints (fixes), the aircraft may be flown in reference to the cross track deviation provided by the FMS or by coupling the FMS roll command to the autopilot.

(1) Entering SID, STAR, Approach, or Airway Waypoints. The following procedure allows the pilot to automatically add waypoints stored in the database, as part of a SID, STAR, approach, or airway to either a stored or active flight plan by entering the SID, STAR, approach, or airway by name. This procedure provides an abbreviated method of waypoint entry, eliminating the need to enter individual waypoint identifiers for SID's, STAR's, approaches, and airways.

NOTE

When a SID, STAR, approach, or airway is added to an existing flight plan, duplicate waypoints may occur. To avoid an inconsistent flight plan and resulting map display, it may be necessary to delete any duplicate waypoints. Also, the routings and coordinates must be verified. These procedures must not be used in lieu of charts.

(a) Entering a SID. Refer to Figure 3A-60.

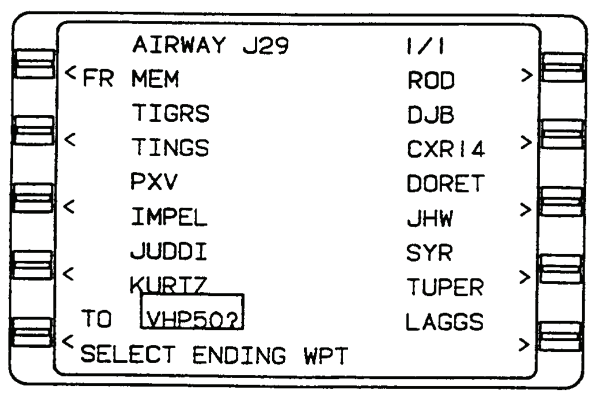


Figure 3A-60. Airway 1/1 Page

1. Line select key – Press to position cursor of the DEPART? field.

2. **ENTER** key – Press to display Departure page.

3. Departure airport – Verify or insert valid identifier.

NOTE

If the first waypoint on the flight plan is an airport, the departure identifier pre-fills and the cursor will be positioned over the SID field.

If the first waypoint on the flight plan is a runway, the RUNWAY field also pre-fills and the cursor is over the SID field.

If there are no SID's associated with the departure airport, the message NO SID's AVAILABLE appears and the ident field will flash. Press the FPL key to return to active flight plan.

4. **BACK** key – Press to display list of available SID's.

5. Line select key – Press to display list of available SID's.

6. **ENTER** key – Press to select SID.

NOTE

Cursor moves to the TRANSITION field.

7. **BACK** key – Press to display list of available TRANSITIONs.

8. Line select key – Press to position cursor over the desired TRANSITION.

9. **ENTER** key – Press to select TRANSITION.

NOTE

If the SID and TRANSITION are runway dependent, and a runway has not pre-filled, the cursor moves to the RUNWAY field and the message RUNWAY REQUIRED appears.

10. **BACK** key – Press to display a list of applicable runways.

11. Line select key – Press to position cursor over the desired runway.

12. **ENTER** key – Press to select RUNWAY.

13. Departure SID waypoints – Review, then press the **ENTER** key to insert SID into active flight plan and return to the Active Flight Plan page.

NOTE

SID waypoints appear indented from other waypoints in a flight plan.

(2) Reviewing a SID.

1. Line select key – Press to position cursor over the DEPART field on the Flight Plan page.

2. **ENTER** key – Press to review SID.

3. **BACK** key – Press.

NOTE

SELECT will not appear as an option since a SID already exists in the flight plan.

(3) Editing a SID.

1. Line select key – Press to position cursor over the DEPART field on the Flight Plan page.

2. **ENTER** key – Press.

3. Line select key – Press to position cursor over the SID field.

4. **BACK** key – Press to display a list of alternate SID'S.

NOTE

A list will only appear if the TRANSITION/ RUNWAY are compatible with other SID's.

5. Line select key – Press to position cursor over the desired SID.

6. **ENTER** key – Press to select desired SID.

7. **ENTER** key – Press to insert new SID into the flight plan.

NOTE

The TRANSITION and RUNWAY can also be edited without changing the original SID by positioning the cursor over the appropriate field and following the above procedure.

(a) Erasing a SID.

1. Line select key – Press to position cursor over DEPART field on the Flight Plan page.

2. **ENTER** key – Press.

3. Line select key – Press to position cursor over ERASE?.

4. **ENTER** key – Press to erase SID and return to Flight Plan page.

(b) Adding SID Waypoints.

NOTE

When a SID is modified by adding or deleting waypoints, the sequence of waypoints is no longer identified as a SID.

1. Line select key – Press to position cursor over the SID waypoint identifier that will follow the new entry.

2. Waypoint identifier – Insert.

3. **ENTER** key – Press twice.

NOTE

The previously indented SID waypoints move over one space to the left on the screen and are treated as normal waypoints in the flight plan.

(c) Deleting SID Waypoints.

NOTE

When a SID is modified by adding or deleting waypoints, the sequence of waypoints is no longer identified as a SID.

1. **BACK** key – Press.

2. **ENTER** key – Press.

(d) Entering An Airway (Destination Waypoint Unknown). En route airways include high altitude jet routes and low altitude airways. Refer to Figure 3A-61.

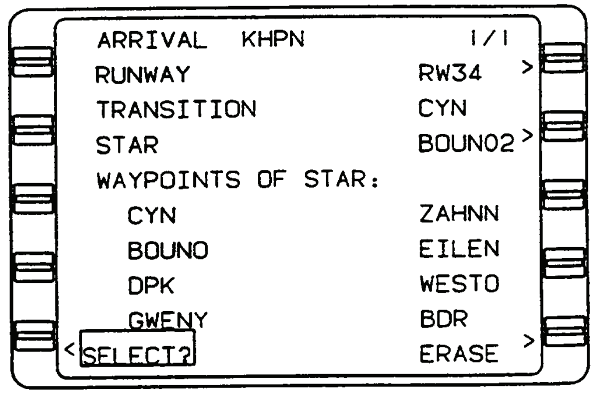


Figure 3A-61. Arrival 1/1 Page

1. Line select key – Press to position cursor directly below the starting waypoint on the desired airway.

2. Airway identifier – Insert.

3. **#** key – Press and enter airway identifier.

4. **ENTER** key – Press.

NOTE

If the waypoint above the cursor is not on the airway, the airway identifier will blink on the screen and a new identifier must be entered.

The flight plan should always be checked for duplicate waypoints and the appropriate waypoints erased.

5. Line select key – Press to position cursor over the desired destination waypoint. If applicable use **PRV** and **NXT** keys to access all Airway Waypoints pages.

NOTE

As the cursor is moved up or down, TO will appear next to the cursor and a question mark will follow the identifier.

6. **ENTER** key – Press after selecting the ending waypoint on the airway. To merge the airway waypoints into the flight plan, return to the Flight Plan page.

NOTE

If inserting the airway segment into the flight plan results in more than 50 waypoints in the flight plan, the message FPL FULL will appear.

(e) Entering an Airway (Destination Waypoint Known). En route airways include high altitude jet routes and low altitude airways.

1. Line select key – Press to position cursor directly below the starting waypoint on the desired airway.
2. Airway identifier – Insert.
3. **#** key – Press and enter airway identifier.
4. **±** key – Press and enter destination waypoint.
5. **ENTER** key – Press.

NOTE

If the waypoint above the cursor is not on the airway, the airway identifier will blink on the screen and a new identifier must be entered. If the destination waypoint is not on the airway, use the procedure for entering an airway (destination waypoint unknown).

6. Line select key – Press to position cursor over a different destination waypoint to change ending waypoint. If applicable, use **PRV** or **NXT** keys to access all airway waypoint pages.

NOTE

As the cursor is moved up or down, TO will appear next to the cursor and a question mark will follow the ident.

7. **ENTER** key – Press to merge the airway waypoints into the flight plan and return to the Flight Plan page.

NOTE

If inserting the airway segment into the flight plan results in more than 50 waypoints in the flight plan, the message FPL FULL will appear.

8. Additional waypoint identifiers – Enter (if applicable) to chain several airways together.

(f) Editing An Airway. Once an airway is merged into the flight plan, waypoints can be added to or deleted from the flight plan on the Flight Plan page using normal edit procedures. To add or delete waypoints from the selected airway segment, perform the following.

1. Line select key – Press to position cursor over an airway waypoint.
2. **#** key – Press and enter appropriate airway identifier.
3. **ENTER** key – Press.
4. Line select key – Press to move the cursor to shorten, lengthen, or erase the previously selected segment of the airway. If applicable, use **PRV** and **NXT** keys to access all Airway Waypoint pages.
5. **ENTER** key – Press to merge the edited airway segment into the flight plan.

(g) Entering a STAR. Refer to Figure 3A-61.

1. Line select key – Press to position cursor over ARRIVE? field.
2. **ENTER** key – Press to display Arrival page.
3. ARRIVAL airport – Verify or insert valid ident.

NOTE

If the last waypoint on the flight plan is an airport or if an approach is programmed, the arrival ident pre-fills and the cursor will be over the first RUNWAY in the list.

If the last waypoint on the flight plan is a runway, the RUNWAY field also pre-fills and the cursor will be over the first TRANSITION in the list.

If there are no STAR's associated with the arrival airport, the message NO STARS AVAILABLE will appear and the identifier field will flash. Press FPL key to return to active flight plan.

4. Line select key – Press to position cursor over the desired TRANSITION.

5. **ENTER** key – Press to select TRANSITION.

NOTE

Cursor will move to the STAR field.

6. Line select key – Press to position cursor over the desired STAR.

7. **ENTER** key – Press to select STAR.

NOTE

If the STAR and TRANSITION are runway dependent, and a runway has not pre-filled, the cursor will move to the RUNWAY field and the message RUNWAY REQUIRED will appear.

8. Line select key – Press to position cursor over the desired RUNWAY.

9. **ENTER** key – Press to select RUNWAY.

10. STAR waypoints – Review, then press **ENTER** key to insert STAR into active flight plan and return to the Active Flight Plan page.

NOTE

STAR waypoints appear indented from the other waypoints on a flight plan.

(h) Reviewing a STAR.

1. Line select key – Press to position cursor over the ARRIVE field on the Flight Plan page.

2. **ENTER** key – Press to review STAR.

3. **BACK** key – Press to return to Flight Plan page.

NOTE

SELECT will not appear as an option since a STAR already exists in the flight plan.

(i) Editing a STAR.

1. Line select key – Press to position cursor over the ARRIVE field on the Flight Plan page.

2. **ENTER** key – Press.

3. Line select key – Press to position cursor over the STAR field.

4. **BACK** key – Press to display a list of alternate STAR's.

NOTE

A list will only appear if the transition is compatible with other STAR's.

5. Line select key – Press to position cursor over the desired STAR.

6. **ENTER** key – Press to select desired STAR.

NOTE

Cursor will move to SELECT? field.

7. **ENTER** key – Press to insert new STAR:x. into the flight plan.

NOTE

The TRANSITION or RUNWAY can also be edited without changing the original STAR by positioning the cursor over the appropriate field and following the above procedure.

(j) Erasing a STAR.

1. Line select key – Press to position cursor over ARRIVE field on the Flight Plan page.

2. **ENTER** key – Press.

3. Line select key – Press to position cursor over ERASE?.

4. **ENTER** key – Press to erase STAR and return to Flight Plan page.

*(k) Adding a **STAR** Waypoint.*

NOTE

When a STAR is modified by adding or deleting waypoints, the sequence of waypoints is no longer identified as a STAR.

1. Line select key – Press to position cursor over the STAR waypoint identifier that will follow the new entry.

2. Waypoint identifier – Insert.

3. **ENTER** key – Press twice.

NOTE

The previously indented STAR waypoints move over one space to the left on the screen and are treated as normal waypoints in the flight plan.

(l) Deleting a STAR Waypoint.

1. Line select key – Press to position cursor over the STAR waypoint identifier that will follow the new entry.

2. **BACK** key – Press.

3. **ENTER** key – Press.

(m) Entering an Approach. Refer to Figures 3A-62 and 3A-63.

NOTE

The system must be configured for radio tuning or VOR inputs to execute RNAV approaches.

1. Line select key – Press to position cursor over APPROACH? field.

2. **ENTER** key – Press to display Approach page.

3. APPROACH airport – Verify or insert valid identifier.

NOTE

If the runway or approach type selected on the Approach page differs from the runway or approach type dictated by the STAR, SEL RWY FROM STAR PG is displayed at the bottom of the screen.

If there are no approaches associated with the approach airport, the message NO APPROACH AVAIL appears and the identifier field flashes. Press FPL key to return to active flight plan.

4. Line select key – Press to position cursor over the desired RUNWAY.

5. **ENTER** key – Press to select RUNWAY. Cursor will move to the TRANSITION field.

6. Line select key – Press to position cursor over the desired TRANSITION.

7. **ENTER** key – Press to select TRANSITION.

8. APPROACH waypoints - Review.

9. **ENTER** key – Press to insert APPROACH into active flight plan and return to the Active Flight Plan page.

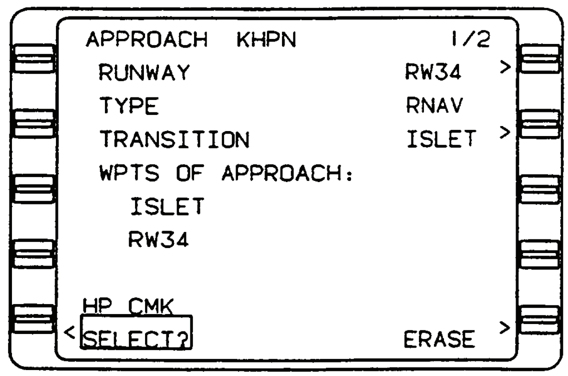


Figure 3A-62. Approach 1/2 Page (Sheet 1 of 2)

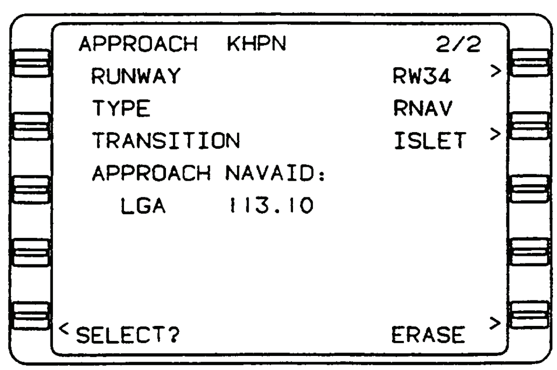


Figure 3A-62. Approach 2/2 Page (Sheet 2 of 2)

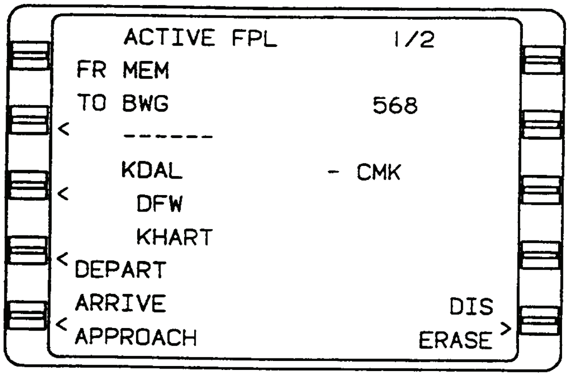


Figure 3A-63. Active FPL 1/2 Page

NOTE

PT indicates a procedure turn waypoint and HP indicates a holding pattern waypoint. A fence (+++++++) separates the missed approach procedure waypoint from the rest of the approach and auto leg changes can only be performed to waypoints before the fence (+++++++).

When the approach is flown, the system will provide guidance along the final approach course to the missed approach point. If the approach is missed, the pilot must manually sequence to the missed approach procedure waypoint using the 1 key.

(4) Executing Approaches.

NOTE

The system is capable of executing GPS overlay NDB, RNAV, and VOR approaches only. No localizer, ILS, or MLS capability is available.

When executing a missed approach procedure, use the FMS heading mode or manually fly the procedure to ensure proper track and turn direction.

(a) Procedure Turn. The following is a description of the screen displays typically seen while executing a procedure turn.

As the aircraft approaches the PT waypoint, a message is displayed on the fourth line of the CDU indicating the next action the aircraft will take. This message is displayed 30 seconds prior to the event and disappears when the action is initiated.

NOTE

Distance (DIS) displayed is the distance from the present aircraft position to the TO waypoint.

Estimated time en route (ETE) is the time around the remainder of the procedure turn from the aircraft's present position.

(5) DME Arc. The following is a brief description of the screen displays typically seen while flying a DME arc.

As the aircraft approaches the AR waypoint, a message is displayed on the fourth line of the CDU indicating the next action the aircraft will take (NX DME ARC). This message will be displayed for 30 seconds prior to the event and will disappear when the action is initiated.

NOTE

DIS displayed is the distance from the present aircraft position to the TO waypoint. ETE is the time around the arc path to the TO waypoint.

(6) Reviewing an Approach.

1. Line select key – Press to position cursor over the APPROACH field on the Flight Plan page.
2. **ENTER** key – Press to review APPROACH.
3. **BACK** key – Press to return to Flight Plan page.

NOTE

SELECT will not appear as an option since an APPROACH already exists in the flight plan.

(7) Editing an Approach.

1. Line select key – Press to position cursor over the APPROACH field on the Flight Plan page.
2. **ENTER** key – Press to display Approach page.

The RUNWAY, TYPE, or TRANSITION may be edited by pressing the line select key next to the field to be edited. That field will turn from green to yellow and the previous information will turn to dashes. Alternate options may be available depending upon the information in the remaining two fields.

NOTE

SELECT will not appear as an option since an APPROACH already exists in the flight plan.

An APPROACH CANCELED message will be displayed anytime an approach has been altered.

3. Line select key – Press to position cursor over the desired TRANSITION.

4. **ENTER** key – Press.

5. **ENTER** key – Press to insert new APPROACH into the flight plan.

(8) Erasing an Approach.

NOTE

Erasing an approach also erases the destination airport.

1. Line select key – Press to position cursor over APPROACH field on the Flight Plan page.

2. **ENTER** key – Press to display Approach page.

3. Line select key – Press to position cursor over ERASE?.

4. **ENTER** key – Press to erase APPROACH and return to the Flight Plan page.

(9) Deleting an Approach Waypoint.

1. Appropriate Flight Plan page – Display.

2. Line select key – Press to position cursor over the APPROACH waypoint identifier that will follow the new entry.

3. **BACK** key – Press.

4. **ENTER** key – Press.

NOTE

When an APPROACH is modified by adding or deleting waypoints (including after the fence), the sequence of waypoints is no longer identified as an approach and the aircraft will not enter the approach mode.

NOTE

An APPROACH CANCELED message will be displayed anytime an approach has been altered.

(10) Using a STAR and an Approach in the Same Flight Plan. Since both the star and approach procedures allow for entry of AIRPORT AND RUNWAY, the following rules apply.

1. Changing the AIRPORT on the arrival page automatically erases the APPROACH procedure.

2. Changing the AIRPORT on the Approach page automatically erases the STAR procedure.

3. Changing the RUNWAY on the Arrival page automatically erases the APPROACH procedure.

4. Changing the RUNWAY on the Approach page has no effect on the STAR procedure unless it is runway dependent.

If the STAR is runway dependent, the message SEL RWY FROM STAR PG (select runway from STAR page) appears on the Approach page. The pilot must return to the Arrival page to change the RUNWAY for the STAR before changing the RUNWAY on the Approach page.

(11) Modifying a Flight Plan.

(a) Accessing Desired Flight Plan. This procedure may be used to modify the active flight plan or any stored flight plan. Access the active plan or stored flight plan by pressing the **FPL** key. Access a stored flight plan from the alphabetized Flight Plan List page, using the **PRV** or **NXT** key to cycle through the available pages. If necessary, refer to the procedure for flight plan selection under pre-departure.

NOTE

A change made to the active flight plan does affect the stored flight plan in memory. Any change made to a stored flight plan remains in memory.

(b) Deleting a Waypoint.

1. Line select key – Press to position the cursor over the waypoint identifier.

2. **BACK** key – Press. DELETE? appears in the waypoint field to inform the pilot of the pending change.

3. **ENTER** key – Press. The waypoint will be deleted and the cursor will be displayed over the next waypoint.

NOTE

To remove a waypoint from nonvolatile memory it must be deleted from all stored flight plans.

(c) Adding a Waypoint. Refer to Figure 3A-63.

A waypoint may be added anywhere in a flight plan sequence, except prior to the current TO waypoint if the Active Flight Plan page is displayed.

1. Line select key – Press to position the cursor over the waypoint identifier that will follow the new entry.

2. Waypoint identifier – Insert.

3. **ENTER** key – Press.

4. Waypoint coordinates – Verify or insert.

5. **ENTER** key – Press. The new waypoint is added to the flight plan sequence and the cursor is over the waypoint following the new entry.

(d) Erasing A Stored Flight Plan.

1. **FPL** key – Press to display the desired Flight Plan List page.

2. Line select key – Press to position the cursor over the number of the FPL to be erased.

3. **ENTER** key – press.

4. Line select key – press to position cursor over ERASE?.

5. **ENTER** key – press.

NOTE

If the active flight plan is erased, all waypoints except the FR and TO are deleted. A fence (----) is displayed indicating no auto leg change beyond the TO waypoint.

(12) Flight Plan (FPL) Selection.

1. **FPL** key or **NXT** key – Press (if required) until desired Flight Plan List page appears.

NOTE

If desired flight plan is not listed refer to the procedure for creating a flight plan.

2. Line select key – Press to position the cursor over the desired flight plan number.

NOTE

If desired flight plan number is known, position the cursor on the page, then enter the number and press ENTER key.

3. **ENTER** key – Press.

4. Flight Plan page – Verify flight plan. Review routing by pressing **PRV** or **NXT** key to page through multiple Flight Plan pages.

NOTE

Press FPL or NXT key to sequence to an alternate flight plan with the same departure destination pair and higher flight plan number.

5. Line select key – Press to position cursor over SELECT?.

6. **ENTER** key – Press to transfer stored flight plan to the active flight plan.

NOTE

If it is desired to invert and transfer the stored flight plan with waypoint sequence reversed to the active flight plan, press the BACK key to display INVERT?.

7. ACTIVE FPL – Confirm. Observe that the stored flight plan transferred to the active flight plan as SELECTED or INVERTED.

(13) Initial Leg Selection.

1. **NAV** key – Press.

2. FR waypoint – Verify. The first waypoint on the active flight plan will appear in the FR field. To change the FR waypoint, insert the desired identifier.

3. **ENTER** key – Press. The next waypoint in the active flight plan sequence will appear in the TO field.

4. TO waypoint – Verify. To change the TO waypoint, insert the desired identifier.

5. **ENTER** key – Press.

6. DIS, DTK – Check.

(14) Manual Primary Navigation Mode Selection. This procedure is used to manually place the system into the primary navigation mode at the designated departure position. The GPS must track at least four satellites in order to navigate, but can also navigate in a degraded mode with three satellites and an external altitude input (air data computer).

1. **MSG** key – Press.

2. NAV RDY, HOLD/ENTER message – Verify. This message indicates that the system is ready to enter the primary navigation mode.

3. **MSG** key – Press to verify status of all sensors.

4. **HOLD** key – Press to verify departure coordinates.

5. **ENTER** key – Press twice to enter primary navigation mode.

(15) En Route.

(a) Direct To Active Flight Plan Waypoint. The direct to key function enables the pilot to fly directly to any waypoint on the active flight plan without reinserting the waypoint identifier.

1. D→ key – Press. A Direct To page will appear with the cursor over the current TO waypoint.

2. Line select key – Press to position the cursor over the desired identifier.

NOTE

Active flight plans exceeding 18 waypoints will be continued on subsequent pages. Press D→ key, NXT, or PRV key to access remaining waypoints.

3. **ENTER** key – Press. Display automatically advances to NAV 1 page.

NOTE

The system must compute a turn from a wings level position. If the aircraft is in a turn when the D→ key is pressed, the aircraft will roll to a wings level position momentarily. The aircraft will then continue the turn toward the DIRECT TO waypoint.

If an offset waypoint was selected, an OFFSET WPT page is displayed. Verify data and press ENTER. The Direct To page is displayed with cursor over offset waypoint. Press ENTER. Display automatically advances to NAV 1 page.

4. DIS, DTK – Check.

(16) Direct To HP Waypoint. This procedure enables the pilot to proceed DIRECT TO the HP waypoint on the active flight plan and select or cancel the holding pattern or procedure turn programmed at the waypoint.

NOTE

Active flight plans exceeding 18 waypoints will be continued on subsequent pages. Press direct to, NXT, or PRV key to access remaining waypoints.

1. D→ key – Press. A Direct To page will appear with the cursor over the current TO waypoint.

2. Line select key – Press to position the cursor over the desired HP identifier.

3. **ENTER** key – Press to display the Holding Pattern page with both the OK? ENTER and CANCEL option.

To select and go directly to HP waypoint:

4. **ENTER** key – Press. Display automatically advances to NAV 1 page.

5. **ENTER** key – Press.

To cancel holding pattern:

6. Line select key – Press to position the cursor over CANCEL?

7. **ENTER** key – Press. Display automatically advances to NAV 1 page and aircraft proceeds directly to waypoint with the holding pattern canceled.

(17) Direct To Random Waypoint. This procedure enables the pilot to add a random waypoint to the active flight plan in the desired sequence and proceed directly to it.

1. D► key – Press. The cursor will automatically appear over the current TO waypoint on the Direct To page.

2. Line select key – Press to position the cursor over the identifier to follow the new entry.

3. Waypoint identifier – Insert.

4. **ENTER** key – Press.

5. Waypoint page coordinates – Verify or insert. To insert waypoint coordinates (cursor over POS field):

   a. Latitude – Insert (N or S first, then degrees, minutes, and tenths of a minute).

   b. **ENTER** key – Press.

   c. Longitude – INSERT (E or W first, then degrees, minutes, and tenths of a minute).

6. **ENTER** key – Press.

7. Waypoint sequence – Verify.

8. **ENTER** key – Press. Display automatically advances to NAV 1 page.

NOTE

If ENTER key is not pressed prior to leaving Direct To page, the waypoint identifier will not appear on the active flight plan and will need to be re-entered.

9. DIS, DTK – Check.

(18) Direct To Closest Airport. This procedure allows the pilot to select a desired airport and proceed DIRECT TO it.

1. D► key – Press until DIR CLOSEST ARP page appears.

When initially accessed, the cursor will be over the airport closest to the aircraft's present position at that time.

2. Line select key – Press to position the cursor over the desired airport identifier and press **ENTER**. The NAV 1 page is displayed.

NOTE

The bearing and distance values to the closest airports are based on the aircraft's present position at the time this page is accessed. The values are not updated while the page is being displayed. To obtain updated information, it is necessary to exit the page, then return.

(19) Pseudo VORTAC. Inbound track, holding patterns. Course guidance is also provided for a selected outbound radial.

1. **NAV** key – Press to display NAV 1 page.

NOTE

R or L should be used for a heading change greater than 180 degrees from the present heading. A T in the HDG and DTK fields indicates that the system is operating in the true heading mode.

2. **ENTER** key – Press. The cursor advances to heading mode field.

3. **ENTER** key – Press to select heading select mode and return to NAV 1 page.

NOTE

HDG SELECT and the programmed heading are displayed on NAV 1 page indicating that the aircraft is in heading select mode.

(20) Changing Heading Vector While In Heading Select Mode.

1. **HDG** key – Press to display Heading Vector page with cursor over the HDG field.

2. Heading – Insert desired heading.

3. **ENTER** key – Press.

NOTE

Cursor moves to the heading mode field, but it is not necessary to press ENTER.

4. **NAV** key – Press to check heading.

(21) Changing To Waypoint While In Heading Select Mode.

NOTE

This procedure establishes a leg between the new TO waypoint and the waypoint preceding it on the active flight plan or a pseudo VORTAC. If crosstrack distance exceeds 125 nautical miles, the HEADING mode will be canceled and the STRG INVALID message will be displayed.

1. **HDG** key – Press to display Heading Vector page.

2. Line select key – Press to position the cursor over the TO waypoint.

3. **BACK** key – Press to cycle through waypoints on the active flight plan or insert alternate waypoint.

4. **ENTER** key – Press. If Waypoint page appears:

   a. Waypoint page coordinates – Verify or insert.

   b. **ENTER** key – Press. Cursor moves to DTK field.

5. DTK – Verify or insert.

6. **ENTER** key – Press. OK? ENTER message will appear.

7. **ENTER** key – Press to select TO waypoint and return to NAV 1 page with the cursor positioned over the leg change mode field.

NOTE

If the desired track is changed, a pseudo VORTAC is programmed. If the DTK entry positions the aircraft on the FROM side of the TO waypoint, the leg change mode displayed on NAV 1 page will switch to MAN; otherwise it remains in AUTO.

(22) Canceling Heading Select Mode. Initiate a DIRECT TO procedure, using the D→ key, which immediately cancels the commanding heading or perform the following.

1. **HDG** key – Press to display Heading Vector page.

2. Line select key – Press to position the cursor over HDG SELECT.

3. **BACK** key – Press until CANCEL? is displayed.

4. **ENTER** key – Press to cancel heading vector and return to NAV 1 page.

(23) Programming An Intercept.

1. **HDG** key – Press to display Heading Vector page with cursor over the HDG field.

2. Heading – Insert desired heading in whole degrees, preceded by R or L, if applicable, to indicate a turn direction.

NOTE

R or L should be used for a heading change greater than 180° from the present heading. A T indicates the system is operating in the true heading mode.

3. **ENTER** key – Press. The cursor advances to heading mode field.

4. **BACK** key – Press to select INTERCEPT?.

5. **ENTER** key – Press. Cursor will move to the TO waypoint field.

6. **BACK** key – Press to cycle through waypoints on the active flight plan or insert alternate waypoint.

7. **ENTER** key – Press. If Waypoint page appears:

a. Waypoint page coordinates – Verify or insert.

b. **ENTER** key – Press. Cursor will move to DTK field.

8. DTK – Verify or insert.

9. **ENTER** key – Press. An intercept message may appear (NO COURSE INTERCEPT or INTERCEPT BEYOND FIX and OK? ENTER).

10. **ENTER** key – Press. NAV 1 page appears, with the cursor positioned over the leg change mode.

NOTE

If the desired track is changed, a pseudo VORTAC is programmed. If the DTK entry positions the aircraft on the from side of the TO waypoint, the leg change mode switches to MAN, otherwise it remains in AUTO.

Once the intercept mode is programmed and the pilot returns to the heading vector page, the intercept message is based on the current aircraft heading. However, to view the intercept message the cursor must be removed from the page.

(24) Programming A Holding Pattern. This procedure enables the pilot to program a Holding Pattern (HP) at a specific waypoint. An HP is automatically programmed from the database when it is part of an arrival or approach procedure.

1. **NAV, FPL**, or →D key – Press to display applicable page.

2. Line select key – Press to position the cursor over desired waypoint.

NOTE

On Navigation pages, only the TO waypoint can be selected, and on the Active Flight Plan page, a holding pattern cannot be programmed at the FR or TO waypoint.

A T adjacent to the value displayed in the INBOUND CRS field indicates that the course is referenced to true north.

3. **HOLD** key – Press to display holding pattern page with cursor over the INBOUND CRS field.

4. INBOUND CRS **–** Verify or insert.

NOTE

A verified inbound course programs a DIRECT ENTRY procedure. When an inserted inbound course value is beyond the DIRECT ENTRY parameters, a TEARDROP or PARALLEL pattern is programmed.

5. **ENTER** key – Press. The type of holding pattern may be displayed. Cursor will move to the LEG TIME field.

6. LEG TIME – Verify or insert (valid range 1.0 to 9.9 minutes).

7. If holding pattern is complete, proceed to step 10. If optional entries are required, continue with steps 8 or 9.

8. Optional entry – Turn direction:

   a. Line select key – Press to position cursor over TURN DIR.

   b. **BACK** key – Press to change direction.

   c. **ENTER** key – Press.

9. Optional entry – leg distance:

   a. Line select key – Press to position the cursor over LEG DIS.

   b. Leg distance – Insert or verify (valid range 1.0 to 50 nautical miles).

   c. **ENTER** key – Press.

10. Selecting exit mode.

   a. Line select key – Press to position the cursor over MANUAL or AUTO**.**

   b. **BACK** key – Press to select. Selecting MANUAL will initiate a continuous hold. Selecting AUTO will exit the hold after the second time over the fix.

   c. **ENTER** key – Press.

(25) Reviewing, Editing, Or Canceling A Holding Pattern. This procedure enables the pilot to

review, edit, or cancel a holding pattern at a specific waypoint.

(a) *Reviewing A Holding Pattern.*

1. NAV, FPL, or -D▶ key – Press to display applicable page.

2. Line select key – Press to position the cursor over HP or PT waypoint.

NOTE

On Navigation pages, only the TO waypoint can be selected, and on the Active Flight Plan page, the TO waypoint can only be reviewed.

3. **HOLD** key – Press to display Holding Pattern page.

4. Holding pattern/procedure turn – Review.

(b) *Editing A Holding Pattern.*

1. Line select key – Press to position cursor over the desired field.

2. Insert value for INBOUND CRS, LEG TIME, or LEG DIS.

3. **BACK** key – Press to change TURN DIR or EXIT MODE.

4. **ENTER** key – Press. The cursor is positioned over OK? ENTER.

NOTE

A re-entry to the holding pattern must be flown if the inbound course or turn direction are changed while holding at the to waypoint.

5. **ENTER** key – Press.

(c) *Canceling a Holding Pattern.*

1. Line select key – Press to position the cursor over CANCEL?.

2. **ENTER** key – Press. The HP annunciation is erased from Navigation, Direct To, and Flight Plan pages.

NOTE

If canceling for the current TO waypoint, HP is replaced by TO.

(26) Exiting A Holding Pattern. This procedure gives the pilot three options to exit a holding pattern: exiting the next time over a holding fix, going DIRECT TO the holding fix, or performing a leg change.

(a) Exiting Holding Pattern the Next Time Over Holding Fix.

1. **NAV** key – Press to display NAV 1, 2, or 3 page.

2. Line select key – Press to position the cursor over MANUAL.

3. **BACK** key – Press to display AUTO?.

4. **ENTER** key – Press. The navigation page indicates that the aircraft will EXIT HOLD the next time over the holding fix (aircraft will complete the loop around the holding pattern).

NOTE

The next (NX) waypoint may also appear if the exit is made during waypoint alert.

(b) Exiting Holding Pattern By Going DIRECT TO Holding Fix.

1. -D▶ key – Press to display Direct To page with cursor over current waypoint.

2. **ENTER** key – Press to display Holding Pattern page with cursor over CANCEL?.

3. **ENTER** key – Press to go DIRECT TO current TO waypoint (holding fix) and cancel holding pattern.

(c) Exiting Holding Pattern by Performing a Leg Change.

1. **NAV** key – Press to display the NAV 1 page.

2. Line select key – Press to position the cursor over FROM field (HOLD RIGHT/LEFT).

3. FR waypoint – Insert desired waypoint

4. **ENTER** key – Press. The next waypoint in the active flight plan sequence will appear in the TO field.

5. TO waypoint – Verify. To change the TO waypoint, insert the desired identifier.

6. **ENTER** key – Press to activate the new leg and cancel the holding pattern.

t. Vertical Navigation Operation Pre-Departure.

(1) Setting Cruise Altitude, Transition Level, and Default Flight Path Angle. This procedure allows the pilot to define a cruise altitude and change the default values for transition level and flight path angle after initial leg selection.

1. **VNAV** key – Press to display VNAV page 1.

2. Line select key – Press to position cursor over DATA?.

3. **ENTER** key – Press to display VNAV DATA with cursor over the CRUISE ALT field.

4. Cruise altitude – Insert.

NOTE

Only two or three digits are required to input an altitude (that is, enter 80 and 8000 will be displayed).

Any altitude entered greater than the TRANS LEVEL, which normally defaults to FL180, is converted and displayed as Flight Level (FL). For example, entering 210 will display FL210.

An altitude less than 1000 feet must be entered with a preceding zero (that is, enter 052 and 52 will be displayed).

NOTE

A (at or above) or B (at or below) constraint entries are not applicable. Setting a cruise altitude will establish a #TOD (top of descent) waypoint or a #TOC (top of climb) waypoint if VNAV is valid. A #TOC will be established only if there are no altitude constraints between the aircraft and #TOC.

5. **ENTER** key – Press.

6. Transition level – Insert or verify.

NOTE

Field defaults to FL180 if pilot does not enter a value. Anytime a TRANS ALT is entered, the value will remain in non-volatile memory even after the system is shut down.

7. **ENTER** key – Press.

8. Default flight path angle (DEFAULT FPA) – Insert or verify (in degrees and tenths of a degree, 0.1 to 6.0 range).

NOTE

Field defaults to 3.0 if pilot does not enter a value. Anytime an FPA is entered, the value will remain in nonvolatile memory even after the system is shut down.

9. **ENTER** key – Press to return to VNAV page.

(2) Creating/Changing VNAV Waypoints. Vertical navigation constraints can only be programmed for waypoints on the active flight plan, and though all active flight plan waypoints are displayed on VNAV pages, new waypoints must be added to the active flight plan before they appear on the VNAV flight plan after initial leg selection.

1. **NAV, FPL**, or **D▶** key – Press to display applicable page.

2. Line select key – Press to position cursor over desired waypoint.

NOTE

On Navigation pages, only the TO waypoint can be selected.

3. **VNAV** key – Press to display VNAV Waypoint page for selected waypoint.

4. ALT – Insert altitude constraint followed by an A (at or above) or a B

(at or below), if applicable. Only two or three digits are required to input an altitude (that is, enter 30A and 3000A will be displayed). Full digit entry may be used to enter an altitude. Altitudes less than 1000 feet are entered with a preceding zero (that is, enter 054 and 54 feet will be displayed). Any altitude entered greater than the transition level is converted and displayed as FL.

NOTE

If the waypoint is part of a SID, STAR, or approach procedure, the altitude constraint pre-fills from database.

5. **ENTER** key – Press. Cursor moves to OFFSET field.

6. OFFSET - If applicable, insert value in nautical miles (-99 to +99 range). If offset is prior to the waypoint, enter the range value and a (-) will pre-fill as a default. Enter a (+), then the range value, to indicate that the offset is beyond the waypoint

NOTE

The cursor moves to the FPA field only if the entered constraint is below the aircraft's present altitude.

To erase the offset value, insert 0 and press ENTER key. The field will change to dashes, indicating that no offset is programmed.

7. **ENTER** key – Press. The cursor moves to the FPA field.

(a) Programming A Descent Path.

NOTE

The FPA value field pre-fills with the default value programmed on the VNAV Data page if this waypoint was accessed from the Flight Plan page. If accessed from the NAV or Direct To page, the field pre-fills with the DIR value. If an FPA is manually entered, the FPA type field changes to MAN.

To cancel the FPA, insert 0 then press ENTER key. The field changes to dashes, indicating no FPA is programmed, the vertical deviation output is invalid and no vertical deviation information will be displayed on the CDU or the EADI/EHSI.

1. FPA – Insert or verify (valid range is 0.1 to 6.0°).

2. With the cursor over the FPA value, press the **BACK** key to cycle through the following.

   a. (DEF) FPA from VNAV Data page.

   b. (AUTO) FPA if the programmed altitude is a cross at type constraint and there is a waypoint prior to the AUTO FPA waypoint that has a cross at constraint programmed. If no constraint is programmed prior to the AUTO FPA constraint the system uses the DEF FPA value as AUTO.

   c. (DIR) FPA when waypoint is called up on a Direct To or Navigation page, altitude crossing is defined, and direct FPA is within valid range.

3. **ENTER** key – Press.

NOTE

When an FPA is programmed at a waypoint, a G appears next to the altitude constraint indicating a glideslope and vertical deviation information will be available. If a glide path is programmed to a runway or ARP and it is not part of an approach procedure, the vertical deviation will become invalid at 1000 feet above the airport elevation.

(3) Reviewing VNAV Database Waypoints. When SID's, STAR's, or approaches have altitude constraints at waypoints on the procedure the system automatically loads the altitude constraints on the active flight plan. The system will not load any except to cross altitudes on the Active Flight Plan page.

NOTE

The system will not fly a full SID or STAR procedure.

(a) Reviewing VNAV Database Waypoints Using Active Flight Plan Page.

1. **FPL** key – Press to display the Active Flight Plan page.

2. Line select key – Press to position the cursor over the desired waypoint.

3. **VNAV** key – Press. The VNAV Waypoint page appears with the cursor over the ALT field.

4. ALT – Review or insert new value.

NOTE

If (AUTO) FPA is displayed, the system has automatically programmed a waypoint to waypoint FPA for the procedure.

5. **ENTER** key – Press until display returns to Active Flight Plan page.

6. Repeat steps 2 through 5 to review or change altitude constraints at remaining waypoints.

(b) Reviewing VNAV Database Waypoints Using VNAV Flight Plan Page.

1. **VNAV** key – Press to display the VNAV page.

2. Line select key – Press to position the cursor over the desired waypoint.

3. **ENTER** key – Press. The VNAV Waypoint page appears with the cursor over the ALT field.

4. ALT – Review or insert new value.

NOTE

If the FPA was retrieved from the database, (DB) will appear in the FPA type field.

5. **ENTER** key – Press to return to the VNAV page.

6. Repeat steps 2 through 5 to review or change altitude constraints at remaining waypoints.

(c) Reviewing VNAV Database Waypoints Using Direct To Or Navigation Pages.

NOTE

A vertical direct can only be programmed for a descent.

1. -D▸ or **NAV** key – Press to display applicable page.

2. Line select key – Press to position the cursor over the desired waypoint on the Direct To page or the TO waypoint on Navigation pages.

3. **VNAV** key – Press. The VNAV Waypoint page appears with cursor over the FPA field, if an altitude constraint has been programmed and the current barometric altitude is above the programmed altitude constraint.

NOTE

When accessing the VNAV Waypoint page from the Direct To page or the Navigation pages, the FPA pre-fills with (DIR) and the direct FPA value from the aircraft's present position to the VNAV waypoint, provided the direct FPA is within the valid range.

The VNAV direct waypoint need not be the same as the lateral to waypoint.

4. **ENTER** key – Press. The waypoint will become the current vertical TO waypoint and all constraints prior to the waypoint will be erased. The VNAV page 1 will appear displaying vertical deviation.

u. Vertical Navigation – En Route.

(1) Programming Path Descents. The pilot can use various methods to set a flight path angle that determines the aircraft's path descent.

NOTE

When the system detects a rapid change of barometric altitude setting or non-continuous data from an air data computer, the vertical deviation output is momentarily interrupted. When vertical deviation returns to a valid state, the appropriate value of vertical deviation will again be displayed.

(a) Programming Path Descents Using Database FPA. The database contains FPA associated with waypoints (for example approaches to runway thresholds) that pre-fill when programmed into the active flight plan. The FPA field on the VNAV Waypoint page displays (DB) and vertical deviation is

provided at the programmed angle when the waypoint becomes the vertical TO waypoint.

(b) Programming Path Descents Using Default FPA. The pilot can select the default FPA, set on the VNAV Data page, by pressing the **BACK** key when the cursor is on the FPA field of the VNAV Waypoint page. The FPA field displays (DEF) and vertical deviation is provided at the programmed angle when the waypoint becomes the vertical TO waypoint.

(c) Programming Path Descents Using Manual FPA. The pilot can enter a desired flight path angle on the VNAV Waypoint page. The FPA field displays (DEF) and vertical deviation is provided at the programmed angle when the waypoint becomes the vertical TO waypoint.

(d) Programming Path Descents Using Automatic FPA. The (AUTO) mode is provided to link together descent waypoints that have cross at type constraints and provide a computed flight path angle between them.

The (AUTO) mode may be selected only if the chosen waypoint has a cross at type constraint programmed. All cross at waypoints that are a part of a STAR or approach are automatically put into (AUTO) mode when the procedure is retrieved from the database and loaded onto the active flight plan.

If the waypoint prior to the selected (AUTO) FPA waypoint has a cross at or above, cross at or below, or cross between constraint programmed, an automatic angle of the programmed default angle on VNAV Data page is assigned. Vertical deviation is provided at the programmed angle when the waypoint becomes the descent reference waypoint.

NOTE

If no ALT constraints are programmed before the selected AUTO FPA waypoint, the AUTO FPA is the same as the DEF FPA.

Unless an FPA is programmed at a waypoint, the system uses the DEF FPA to the first waypoint on the flight plan with an altitude constraint to establish #TOD. To help establish #TOD, the system will automatically load the destination airport elevation on the flight plan, provided the flight plan was not obtained from AFIS. An altitude constraint and FPA must be programmed to establish a path descent and activate vertical deviation.

(2) Editing Altitude Constraints. The pilot can edit altitude constraints for waypoints on subsequent VNAV pages, referred to as VNAV Flight Plan pages, by using the VNAV page or the VNAV Waypoint page.

(a) Editing Altitude Constraints Using VNAV Page.

1. **VNAV** key – Press to display VNAV 1/2 page. The altitude constraint may be changed on this page if the current TO waypoint has a constraint programmed. Type the altitude in the altitude field. All parameters associated with the previous constraint will remain unchanged (that is, FPA, A, B, G, or OFFSET).

2. **VNAV** key – Press to position the cursor over the desired waypoint altitude.

3. Line select key – Press to position the cursor over the desired waypoint altitude.

4. Altitude constraint – Insert new altitude constraint followed by A (at or above) or B (at or below), if applicable. Any altitude entered greater than the transition level is converted and displayed as FL (flight level, rounded off to the nearest hundred feet). An altitude less than 1000 feet must be entered with a preceding zero.

5. **ENTER** key – Press.

(b) Editing Altitude Constraints Using VNAV Waypoint Page.

1. **NAV, FPL**, or **-D▸** key – Press to display applicable page.

2. Line select key – Press to position cursor over desired waypoint.

NOTE

On Navigation pages, only the TO waypoint can be selected.

3. **VNAV** key – Press to display VNAV Waypoint page for selected waypoint.

4. ALT – Insert altitude constraint followed by A (at or above) or B

(at or below), if applicable. Only two or three digits are required to input an altitude (for example, enter 30A and 3000A will be displayed).

Any altitude entered greater than the transition level is converted and displayed as FL. An altitude less than 1000 feet must be entered with a preceding zero.

NOTE

If the waypoint is part of a SID, STAR, or approach procedure, the altitude constraint will pre-fill from the database. Cross between two altitude type constraints cannot be programmed manually.

5. **ENTER** key – Press. Cursor will move to OFFSET field.

6. **ENTER** key – Press. Cursor will move to the FPA field.

7. **ENTER** key – Press to return to the page where the VNAV waypoint was accessed.

(3) Direct To *VNAV Waypoint As A Lateral Waypoint.* This procedure enables the pilot to proceed DIRECT TO a waypoint, both vertically and laterally.

1. —D► key – Press. A Direct To page will appear with the cursor over the current TO waypoint.

2. Line select key - If applicable, press to position cursor over desired waypoint.

NOTE

Active flight plans containing more than 18 waypoints will display the remaining waypoints on subsequent pages. Press the —D► key again, or NXT key, to access the remaining pages.

3. **ENTER** key – Press. CDU screen automatically advances to NAV 1 page.

NOTE

If an offset waypoint was selected, the system displays the Offset Waypoint page. Verify data and press ENTER. The Direct To page will again be displayed with the cursor over the offset waypoint. When ENTER is pressed, the display will automatically advance to NAV 1 page.

4. Line select key – Press to position cursor over the TO waypoint.

5. **VNAV** key – Press to display the VNAV Waypoint page for TO waypoint.

6. ALT – Insert or verify. If an altitude constraint has already been programmed, the cursor will be displayed over the (DIR) FPA field and proceed to step 10.

NOTE

If the waypoint is a part of a SID, STAR, or approach procedure, the altitude constraint will pre-fill from the database.

7. **ENTER** key – Press. Cursor will move to OFFSET field.

8. OFFSET – If applicable, insert value in nautical miles (-99 to +99 range).

   a. If offset is prior to the waypoint - Enter range value and a (–) will pre-fill as a default.

   b. If offset is beyond waypoint - Enter a (+), then range.

NOTE

To erase the offset value, insert 0 and press ENTER key. The field will change to dashes, indicating that no offset is programmed.

Cursor will only move to the FPA field if altitude constraint is below current barometric altitude.

9. **ENTER** key – Press. Cursor will move to the FPA field.

NOTE

Direct flight path angle pre-fills if it is within the valid range (0.1 to 6.0 degrees).

10. Flight path angle – Verify direct flight path angle is desirable to fly.

11. **ENTER** key – Press to accept waypoint entries. VNAV page 1 is displayed and vertical deviation is enabled if a descent has been programmed.

(4) Direct To VNAV Waypoint. This procedure allows the pilot to program a direct to on the vertical flight plan, while still flying the lateral waypoints on the active flight plan. The VNAV direct to function automatically deletes any intermediate constraints and sets up a path descent to the vertical to waypoint using the direct flight path angle.

1. -D→ key – Press. A Direct To page will appear with the cursor over the current TO waypoint.

2. Line select key – Press to position cursor over desired waypoint.

3. **VNAV** key – Press. VNAV Waypoint page will appear. If necessary, position cursor over ALT field. If a constraint has already been programmed, go to step 8.

4. ALT – Insert or verify.

5. **ENTER** key – Press. Cursor will move to OFFSET field.

6. OFFSET - If applicable, insert value in nautical miles (-99 to +99 nautical mile range).

   a. If offset is prior to the waypoint - Enter range value and a (–) will pre-fill as a default.

   b. If offset is beyond waypoint - Enter a (+) then range value.

7. **ENTER** key – Press. Cursor moves to FPA field.

NOTE

Direct flight path angle pre-fills if it is within the valid range.

8. Flight path angle Verify or insert (0.1 to 6.0 degree range).

9. **ENTER** key – Press to accept waypoint entries and return to VNAV page 1.

(5) Creating VNAV Profile Waypoints. VNAV profile waypoints (#TOC, #TOD, and #PRESL) are used to provide a prediction of the position of the aircraft on the vertical flight path. These are non-enterable waypoints computed by the system based on current groundspeed and vertical speed.

(a) Top Of Climb (#TOC). Top of climb altitude is obtained from either the CRUISE ALT entered by the pilot on the VNAV Data page, or from the altitude pre-selector setting, if available. When the aircraft arrives at the pre-selected altitude, the system will automatically set cruise altitude to the pre-selected altitude which will provide a #TOD prediction.

If vertical climb constraints are programmed, #TOC will automatically appear as a waypoint when the aircraft laterally passes the last vertical waypoint that has a climb constraint. Once the aircraft has crossed the final climb constraint waypoint, #TOC will then become the vertical TO waypoint. If there are no vertical constraints programmed for climb, #TOC will be displayed as the first vertical waypoint as long as the aircraft is in a climb.

When the programmed cruise altitude is reached, #TOC is removed from the VNAV flight plan, and #TOD becomes the vertical TO waypoint.

(b) When #TOC is the TO Waypoint. The pilot may obtain range and ETE to any altitude above the aircraft during a climb.

1. **VNAV** key – Press to display VNAV page 1.

2. Line select key – Press to display VNAV page 1.

3. Alternate altitude – Insert. This value may be above or below the altitude pre-select value, but must be above the current barometric altitude.

4. **ENTER** key – Press and observe the change in RANGE and ETE.

5. Previous #TOC altitude setting - Return to.

NOTE

Changing CRUISE ALT on the CDU to a lower altitude should only be done after the aircraft has departed cruise altitude, or #TOD at the current cruise altitude will be lost.

(c) Top Of Descent (#TOD). The top of descent waypoint is the position where the aircraft will intercept the descent path at the cruise altitude. The system calculates the #TOD by establishing a valid descent reference waypoint, then uses either the CRUISE ALT entered by the pilot on the VNAV Data page, or the altitude pre-selector setting, if available.

If no descent reference waypoint with crossing altitude is programmed, the system will use the arrival airport and elevation, ARP reference point, not a runway, to fix top of descent as long as an AFIS flight plan is not used.

One minute prior to arriving at #TOD, the system issues the VNAV WPT ALERT message and the discrete waypoint light will flash for 10 seconds, then be steady.

(d) Pre-Selected Altitude Intercept Point (#PRESL). When the system has an input from an altitude pre-selector and the aircraft is flying toward this altitude, a profile waypoint (#PRESL) appears on the VNAV page. #PRESL, however, never becomes the vertical TO waypoint. When the pre-selector input is valid, ETE and RANGE to #PRESL can be found on the VNAV Data page.

(e) Descent Reference Waypoints. Descent reference waypoints have a fixed altitude crossing. To create a descent reference waypoint, the pilot can program a flight path angle or a cross at altitude constraint.

If a programmed FPA violates a prior vertical constraint, the system reassigns the descent reference waypoint, using the default FPA from the VNAV Data page.

v. Remote Tuning.

(1) Tuning Communications Radios. This procedure enables the pilot to keyboard tune the aircraft radios via the CDU.

1. **TUNE** key – Press. The Comm Radio Tune page will be displayed.

2. Line select key – Press (if necessary) to position cursor over appropriate PRESET field.

3. Frequency – Insert.

NOTE

Trailing zeroes are not required.

4. **ENTER** key – Press. TRANSFER? will automatically appear.

5. **ENTER** key – Press. The entered PRESET frequency transfers to ACTIVE and displays for a few seconds before it goes to dashes. The new frequency also displays as the ACTIVE frequency on the appropriate comm control unit.

NOTE

(MAN) adjacent to active comm frequency indicates that the frequency has been entered using the comm control unit. No prompts are displayed when active comm frequency has been keyboard entered.

The PRESET frequency displayed on the control head is not necessarily the PRESET frequency displayed on the CDU. Each may be entered independently.

Depending on the system configuration, the cursor can appear over the PRESET field for either COMM 1 or COMM 2.

(2) Tuning NAV Radios By Keyboard Method If Station Identifier Is Used.

1. **TUNE** key – Press until Navigation Tune page is displayed.

2. Line select key – Press to position cursor opposite the desired radio (NAV 1 or NAV 2).

3. Station identifier – Insert or verify entry.

4. **ENTER** key – Press. The new frequency is displayed immediately and is annunciated with (KEY) adjacent to the frequency field. If the identifier is not found immediately, the IDENT field will go to dashes until the station is located in the database. Once located, the identifier will be displayed and the (KEY) annunciation will shift to the identifier line.

NOTE

When the CDU keyboard is used to tune a navaid, the database will pair the frequency and identifier to the nearest usable navaid. Therefore, the identifier entered may not be the same as the identifier that is displayed. If the navaid is out of range, or a frequency conflict exists, dashes will be displayed in the IDENT field and the new frequency will be displayed.

5. Frequency – Verify that the ACTIVE frequency on the control head and CDU displays agree.

(3) Tuning NAV Radios By Keyboard Method If Station Frequency Is Used.

1. **TUNE** key – Press until Navigation Radio Tune page 1 is displayed.

2. Line select key – Press to position cursor over desired FREQ field.

3. Frequency – Insert or verify.

NOTE

Trailing zeroes are not required.

4. **ENTER** key – Press.

NOTE

(MAN) adjacent to the FREQ field indicates that the frequency has been entered manually from the NAV control head.

5. Frequency – Verify that control head display is tuned to the desired frequency. When the station is located in the database the identifier will be displayed and the (KEY) annunciation will shift to the identifier line.

6. RANGE and BRG – Check.

(4) Tuning NAV Radios By Auto Tune Method.

NOTE

DME hold, manual control unit tuning, keyboard tuning, or use of the AUTO / MAN switch will take the flight management system out of the auto tune mode.

Only NAV/DME radios may be placed in the AUTO TUNE mode.

1. **TUNE** key – Press to display the Navigation Radio Tune page.

2. Line select key – Press to place cursor over IDENT or FREQ field in NAV 1 or 2.

3. **BACK** key – Press. AUTO? is displayed in place of (KEY) or (MAN).

4. **ENTER** key – Press to place system in AUTO TUNE mode. After a brief pause the CRT information will change to reflect the identifier chosen by the system.

NOTE

No prompt is displayed adjacent to the IDENT field when system is in AUTO TUNE mode.

5. FREQ, RANGE, and BRG – Check that the frequency of the control unit and CDU display agree and that range and bearing are reasonable.

(5) Transponder And ADF Keyboard Tune.

NOTE

(MAN) adjacent to ADF or XPDR indicates that the frequency or code has been entered manually from the control unit.

1. **TUNE** key – Press to display the page with XPDR and ADF.

2. Line select key – Press to position the cursor over the desired code or frequency field.

3. Code or frequency – Insert and verify new value.

4. **ENTER** key – Press. (MAN) field will disappear indicating radios have been keyboard tuned. Verify that the code or frequency changes on CDU (frequency only will appear for a few seconds before going to dashes) and control head displays.

w. Planning Procedures.

(1) Fuel Planning. Refer to Figure 3A-64.

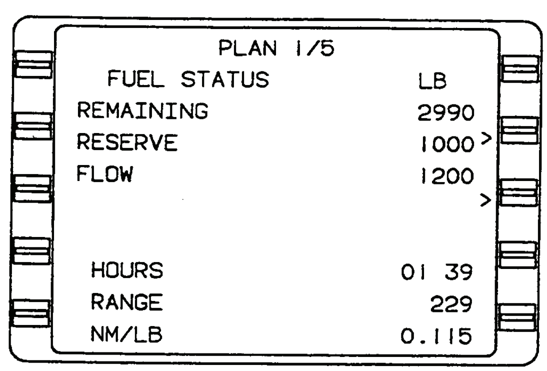


Figure 3A-64. Fuel Status Page

1. **PLAN** key – Press to display Fuel Status page.

NOTE

REMAINING and RESERVE quantities are stored in nonvolatile memory after system shutdown. Upon system turn-on, VERIFY INPUTS will be displayed and REMAINING, RESERVE, and FLOW values will flash.

2. Line select key – Press to position cursor over REMAINING field.

3. Fuel quantity remaining – Verify or insert.

4. **ENTER** key – Press.

5. Fuel reserve – Verify or insert.

6. **ENTER** key – Press.

NOTE

No fuel flow entry is required in the automatic fuel flow mode. All flashing fields must be verified or values inserted using the ENTER key, in order for HOURS, RANGE, and NM/LB fields to display information.

7. Fuel flow – Insert or verify.

8. **ENTER** key – Press. If a manual fuel flow is entered, the VERIFY INPUTS message changes to LAST INPUT and sets the time at :00 minutes. (MAN) will be displayed adjacent to the FLOW field.

When the LAST INPUT field exceeds 15 minutes, the REMAINING, RESERVE, and FLOW fields blink indicating verification or update is required. REMAINING, RESERVE, and FLOW fields will blink. Verify input is required (repeat steps 2 through 7).

9. Data – Check. HOURS of fuel and RANGE are calculated to the RESERVE fuel, not zero fuel, unless the RESERVE fuel is zero.

RANGE and NM/LB or NM/KG (specific range) are calculated based on current groundspeed. Dashes are displayed for these values until a valid groundspeed is acquired.

(a) Changing Unit Of Measurement (LB Or KG).

1. Line select key – Press to position the cursor over the unit field, LB or KG.

2. **BACK** key – Press. The field will display LB? or KG? to notify the pilot of the pending change.

3. **ENTER** key – Press. The units field on the title line and specific range line will change. All fuel figures are recalculated to reflect the new units of measurement.

(2) Trip Planning. The Trip Plan page provides the capability to calculate information for active or stored flight plans, DIRECT TO legs, or random legs without affecting the system's navigation functions.

1. **PLAN** key – Press to display Trip Plan page.

NOTE

Initially the Trip Plan page will display the active flight plan (if present). The initial leg displayed will be DIRECT TO the current TO waypoint on the active flight plan or the first TO waypoint on the flight plan selected.

2. Line select key – Press to position the cursor over the TRIP PLAN field.

3. Desired flight plan – Insert flight plan number or A for active flight plan.

4. **ENTER** key – Press.

NOTE

If a flight plan number is left in the TRIP PLAN field and not returned to A, no updated active flight plan information will be displayed.

5. FR waypoint Verify or insert as required. If DIRECT is displayed go to step 7.

6. **ENTER** key – Press.

7. TO waypoint – Verify or insert as required.

NOTE

With TRIP PLAN A selected, the TRIP PLAN leg will automatically advance to display DIRECT TO the current navigation page to waypoint each time the Trip Plan page is accessed.

8. **ENTER** key – Press.

9. Groundspeed – Verify. Current aircraft groundspeed is displayed unless a manual entry is made. Enter manual groundspeed as follows:

   a. Line select key – Press to position cursor over GS field.

   b. Groundspeed – Insert.

   c. **ENTER** key – Press. MAN will appear adjacent to the GS field.

To return to automatic groundspeed:

   d. Line select key – Press to position cursor over GS field.

   e. **BACK** key – Press. AUTO? appears in the GS field to inform pilot of the pending change and current GS is displayed in the cursor.

   f. **ENTER** key - Press.

10. Data – Check. When DIRECT is displayed, all data except DTK is updated continuously. If data is not continuously updated, it will be recalculated each time:

   a. The Trip Plan page is selected.

   b. A TRIP PLAN is entered.

   c. A leg change is made on the Trip Plan page. ETE and FPL time are recalculated whenever the groundspeed changes.

   d. Leg or GS change is made on the Fuel Plan page.

NOTE

ETA@ the destination is displayed only when DIRECT legs are being viewed.

NOTE

If the Trip Plan page is being displayed during a leg change (on the Active Flight Plan page), the new TO waypoint is not displayed. Exit and return to the Trip Plan page to view the updated TO waypoint.

Information between any desired waypoints can be reviewed by selecting the Trip Plan page and entering a FROM and TO waypoint, accomplishing manual leg change, or performing the present position direct procedures. If the TO waypoint is not on the selected flight plan, the flight plan number and origin/ destination fields will display dashes.

11. Remainder of flight plan. Review by positioning cursor over TO field and pressing **ENTER** key twice to call up next leg. Press **ENTER** key once for each subsequent leg. Groundspeed should be updated if necessary.

(a) Updating TRIP PLAN Leg To The Current TO Waypoint With An Active Flight Plan Selected.

1. Line select key – Press to position cursor over TRIP PLAN field.

2. Enter the letter A in the cursor field.

3. **ENTER** key – Press twice to display information in the data fields.

NOTE

If an offset waypoint is in the TO field, the OFFSET WPT will appear. Press the ENTER key again.

The TRIP PLAN leg will display DIRECT TO the current navigation page TO waypoint.

Selecting another display page, other than MSG and Fuel Plan, and returning to the Trip Plan page will also update the leg with DIRECT TO the current navigation page TO waypoint.

(3) Flight Plan Fuel Planning. The Fuel Plan page provides the capability to calculate fuel consumption information for active or stored flight plans, DIRECT TO legs, or random legs without affecting any of the system's navigation functions.

The fuel plan number and origin and destination identifiers, TO / FROM leg and groundspeed value on this page will be identical to the Trip Plan page. Changing GS or the current leg on the Fuel Plan page also affects the Trip Plan page. Pilot initiated changes made to the FLOW field on the Fuel Status page are reflected on the Fuel Plan page.

1. **PLAN** key – Press to display Fuel Plan page.

NOTE

Initially, the FUEL PLAN will display the active flight plan, if selected. The initial leg displayed will be DIRECT TO the first TO waypoint.

2. Line select key – Press to position the cursor over the FUEL PLAN field.

NOTE

If a flight plan number is left in the fuel plan field and not returned to A, no updated active flight plan information will appear.

3. Desired flight plan – Insert flight plan number or A for active flight plan.

4. **ENTER** key – Press.

5. FR waypoint – Verify or insert as required. If DIRECT is displayed, go to step 7.

6. **ENTER** key – Press.

7. TO waypoint – Verify or insert as required.

NOTE

With a FUEL PLAN A selected, the FUEL PLAN leg automatically advances to display DIRECT TO the navigation page TO waypoint each time the Fuel Plan or Trip Plan page is accessed.

8. **ENTER** key – Press.

9. Groundspeed – Verify. The current aircraft groundspeed is displayed unless a manual entry is made.

10. Manual groundspeed – Enter as follows:

    a. Line select key – Press to position cursor over GS field.

    b. Groundspeed – Insert.

    c. **ENTER** key – Press. (MAN) will appear adjacent to GS field.

11. Automatic groundspeed – Return to as follows.

    a. Line select key – Press to position cursor over GS field.

    b. **BACK** key – Press. AUTO? appears in the GS field to inform pilot of the pending change and current GS is displayed under the cursor.

    c. **ENTER** key – Press.

12. Manual fuel flow – Enter as follows:

    a. Line select key – Press to position cursor over FLOW field.

    b. Fuel flow – Insert.

    c. **ENTER** key – Press. (MAN) will appear adjacent to the FLOW field.

13. Automatic fuel flow – Return to as follows.

    a. Line select key – Press to position cursor over FLOW field.

    b. **BACK**. key – Press to position cursor over **FLOW** field to inform pilot of the pending change and current flow will be displayed under the cursor.

    c. **ENTER** key – Press.

14. Data – Check. When DIRECT is displayed, all data is continuously updated. If data is not continuously updated, it will be recalculated each time:

    a. The Trip Plan page has changes in FR/TO leg or GS.

    b. The Fuel Plan page is selected.

    c. Leg or GS change is made on the Fuel Plan page. LEG FUEL and

FPL FUEL are recalculated whenever the FLOW changes.

d. FUEL FLOW is changed on Fuel Status page.

NOTE

The REM@ field only appears when a DIRECT TO leg is displayed.

Information between any desired waypoints can be reviewed by selecting the Fuel Plan page and entering a FROM – TO leg or by executing the present position direct procedures. If the TO waypoint is not on the selected flight plan, the flight plan number and origin/ destination fields will display dashes.

15. Remainder of flight plan – Review by positioning cursor over TO field then pressing **ENTER** key twice to call up the next leg. Groundspeed and/or fuel flow should be updated if necessary.

16. With an active flight plan selected to update the FUEL PLAN leg to current TO waypoint, perform the following.

    a. Line select key – Press to position cursor over FUEL PLAN A field.

    b. Letter A – Enter in cursor field.

    c. **ENTER** key – Press twice to display information in data fields.

The FUEL PLAN leg displays DIRECT TO the current navigation page TO waypoint.

Selecting another display page, other than MSG and Trip Plan, and returning to Fuel Plan page also updates the leg with DIRECT TO the current navigation page TO waypoint.

(4) Verifying Or Changing Date And Time.

NOTE

If necessary, both DATE and GMT can be corrected on this page.

GMT may be updated to GPS time by placing the cursor over the GMT data field and pressing BACK key. If GPS time is available, GPS? will appear under the cursor. Press ENTER key to update GMT to GPS time.

(a) DATE. This field displays current date same as Initialization page.

(b) GMT. This field displays current GMT same as Initialization page.

NOTE

TAKEOFF and LAND may be based on groundspeed and/or TAS depending upon system configuration.

(c) TAKEOFF. This field displays the GMT at weight off wheels.

(d) LAND. This field displays the GMT at weight on wheels.

(e) FLIGHT TIME. This field displays the elapsed flight time in hours and minutes.

(5) Verifying Or Changing Aircraft Weight Parameters. This procedure allows the pilot to confirm or adjust basic operating weight, payload, or fuel to current on board data.

1. **PLAN** key – Press to display Aircraft Weight page.

NOTE

BASIC OP WT, PAYLOAD, and FUEL ON BOARD fields will be blinking if update has not been entered after system power up.

FUEL USED will remain dashes until auto fuel flow is detected.

2. Line select key – Press to place the cursor over flashing weight field.

3. BASIC OP WT – Verify or insert.

4. **ENTER** key – Press.

5. PAYLOAD – Verify or insert.

6. **ENTER** key – Press.

7. FUEL ON BOARD – Verify or insert.

8. **ENTER** key – Press.

NOTE

VERIFY INPUTS field will disappear and a GROSS WT value will replace dashes, and weights will no longer blink.

NOTE

VERIFY FUEL message will replace VERIFY INPUTS message when MAN fuel flow is being used and FUEL ON BOARD has not been verified or updated on PLAN.

All blinking weight fields must be verified or values inserted using the ENTER key, for GROSS WT field to display information.

(6) Special Procedures. The following are various procedures that can be performed during navigation, when applicable.

(a) Pilot Entered Leg Change.

1. **NAV** key – Press to select Navigation page. A pilot entered leg change may be accomplished on any navigation page with a FR/TO field. However, NAV 1 page is recommended to simplify a reasonability check of DIS and DTK.

2. Line select key – Press to position cursor over the FR field.

3. FR waypoint identifier – Insert or verify.

4. **ENTER** key – Press. If inserting a waypoint identifier not found in the active flight plan, or an offset waypoint, a Waypoint page will appear. The following procedure should be performed if a Waypoint page appears:

   a. Waypoint page coordinates – Verify database waypoint or insert pilot entered waypoint. To insert waypoint coordinates (cursor over POS field):

   b. Latitude – Insert (N or S first, then degrees, minutes and tenths of a minute).

   c. **ENTER** key – Press.

   d. Longitude – Insert (E or W first, then degrees, minutes, and tenths of a minute).

   e. **ENTER** key – Press.

5. If verifying current FR waypoint – Press **ENTER** key and cursor box will expand to enclose both FR and TO waypoint identifiers, which will activate the TO field.

6. TO waypoint identifier – Insert or verify.

7. **ENTER** key – Press. If a Waypoint page appears:

   a. Waypoint page coordinates – Verify database waypoint or insert pilot entered waypoint. To insert waypoint coordinates (cursor over POS fields).

   b. Latitude – Insert (N or S first, then degrees, minutes, and tenths of a minute).

   c. **ENTER** key – Press.

   d. Longitude – Insert (E or W first, then degrees, minutes, and tenths of a minute).

   e. **ENTER** key – Press.

8. DIS, DTK – Check.

NOTE

The pilot entered leg change procedure inserts a fence indicated by (-----) on the Direct To and Active Flight Plan pages preventing auto leg change beyond the TO waypoint. If the TO waypoint was not on the original active flight plan, the MSG light illuminates and the system message page displays NO AUTO LEG CHG, but the AUTO field on NAV 1 page continues to display AUTO.

(b) Preventing Automatic Leg Changes. The auto leg change function allows the system to automatically sequence from waypoint to waypoint on the active flight plan. When the system is initialized it is in the automatic leg change mode unless changed by the pilot. The following procedure inhibits automatic leg changes.

1. **NAV** key – Press to display NAV 1 page.

2. Line select key – Press to position cursor over AUTO.

3. **BACK** key – Press. Cursor field will display MAN? to inform the pilot of the pending change.

4. **ENTER** key – Press. The cursor will disappear and MAN will remain in the field confirming that leg changes must be made manually. NO AUTO LEG CHG message will appear on the System Messages page, however the MSG light will not illuminate.

(c) Returning To Automatic Leg Change Mode.

1. **NAV** key – Press to display NAV 1 page.

2. Line select key – Press to position cursor over MAN.

3. **BACK** key – Press. The cursor disappears and AUTO remains in the field confirming return to the automatic leg change mode. NO AUTO LEG CHG message on the system messages page disappears unless the current TO waypoint is the last waypoint on the active flight plan.

(7) External Waypoint Acceptance. Up to 99 external waypoints may be accepted from an interfaced radar or EFIS. When a waypoint is generated from this equipment, a DIRECT TO leg change is made to that waypoint. The generated waypoint will be designated EX#01 to EX#99.

As the external waypoint (EX#) is off the flight plan, it will be separated from the active flight plan waypoint sequence and a NO AUTO LEG CHG message will appear on the System Messages page. The following procedure may be used to link the EX# waypoint into the flight plan sequence.

1. **D►** key – Press. The display will show direct to the EX# waypoint with the complete active flight plan listed below.

2. Line select key – Press to position the cursor over the waypoint to follow the EX# waypoint.

3. EX# waypoint identifier – Insert.

4. **ENTER** key – Press.

NOTE

The EX# waypoint identifier will flash if an unassigned number is entered. EX# waypoint coordinates can only be assigned by an external source (radar or EFIS).

5. Waypoint page coordinates – Verify.

6. **ENTER** key – Press.

7. Waypoint sequence – Verify.

8. **ENTER** key – Press. CDU display will automatically advance to Navigation page and NO AUTO LEG CHG message will be removed from the System Messages page.

(8) Present Position As A Waypoint. A special waypoint location is reserved for storing present position coordinates as a waypoint. The identifier for this waypoint is inserted as #1. The identifier may be used as a parent identifier for an offset waypoint by adding an *.

NOTE

Since waypoint #1 is frequently redefined, it is not retained in nonvolatile memory and the identifier #1 cannot be entered on a stored flight plan. It does, however, use up one of the 999 available waypoints, as do #OFF and EX waypoints.

Waypoint #1 is redefined each time the **HOLD** key is pressed. An example of the application of waypoint #1 is to store the coordinates of a point overflown to which you may wish to return. This is accomplished by pressing the **HOLD** key directly over that desired point. In this case these coordinates would be stored under identifier #1 until either the **HOLD** key is pressed again, updating #1, or the system is shut down.

(9) Navigation At Extreme Latitudes (North Of 70 ºN Or South Of 60 °S).

WARNING

The procedures listed in this section contain instructions for operation of the flight management system at specified latitudes beyond the autocomputed magnetic variation mode. In all cases, the flight crew of any aircraft operating at these latitudes must consult the flight manual supplement in order to obtain satisfactory performance and accuracy.

(a) Manual Magnetic Variation Entry.

1. **NAV** key – Press to display until NAV 3 page is displayed.

2. Line select key – Press to place cursor over the VAR field.

3. Local variation – Insert (E or W first).

4. **ENTER** key – Press. (MAN) will be annunciated adjacent to the VAR field.

(b) Returning To Automatic Variation.

1. **NAV** key – Press until NAV 3 page is displayed.

2. Line select key – Press to place cursor over VAR field.

3. **BACK** key – Press. AUTO? will be displayed to advise the pilot of the impending change.

4. **ENTER** key – Press.

(10) True Heading.

NOTE

This procedure must be accompanied by the input of true heading into the system.

1. **NAV** key – Press until NAV 3 page appears.

2. Line select key – Press to place cursor over the VAR field.

NOTE

The variation is now E0 and the system will be referenced to true north. There will be no T annunciation to BRG, HDG, and TK.

3. E0 – Insert.

4. **ENTER** key – Press.

x. Loss of Power in Flight.

NOTE

This procedure should only be used in a remote area where navaids are unavailable and there is reason to believe that the sensors contributing to the composite position may be in error.

This procedure allows the pilot to initialize en route when the aircraft has sustained a loss of power for more than 7 seconds. The power off waypoint (**#OFF**) provides a snapshot of system data at the moment power was lost.

(1) Initialization When Power Is Restored.

NOTE

When power returns, system will perform self-test and will display the Initialization page.

1. DATE and GMT – Verify or enter current DATE and GMT if required.

2. **ENTER** key – Press to place the cursor over the POS field, if required.

NOTE

The coordinates are a rolling display of the real time blended position of the sensors being updated.

3. **ENTER** key – Press to accept real time position.

4. **HOLD** key -Press.

5. Power off waypoint identifier – Insert #OFF.

6. **ENTER** key. – Press.

7. MINUTES, LAST TK, LAST GS – Verify and record for future use.

8. **BACK** key – Press to return to Hold page.

NOTE

An offset waypoint (#OFF*) can be input with a radial based on the LAST TK value and distance calculated from the LAST GS value as well as the time elapsed from power off, provided significant changes to aircraft track or groundspeed have not been made. If the aircraft has turned or if the speed has changed, the pilot should estimate the track and distance traveled since loss of power.

9. Offset waypoint identifier – Insert.
10. **ENTER** key – Press.
11. Recorded or estimated radial – Insert LAST TK value or averaged value.
12. Recorded or estimated radial – Insert LAST TK value or averaged value.
13. Distance – Insert calculated distance in nautical miles and tenths of a nautical mile.
14. **ENTER** key – Press.
15. Waypoint coordinates – Verify for reasonability.
16. **ENTER** key – Press.
17. DIF - Check.
    a. If update is desired: **ENTER** key - Press.
    b. If update is not desired: **NAV, PLAN, FPL, TUNE, *VNAV*, HDG,** or -D→ key – Press to cancel the HOLD.

y. Creating/Changing Pilot Entered (Personalized) Waypoints. A personalized waypoint may be created by entering a non-ICAO waypoint identifier and inserting the desired position coordinates on the Waypoint page.

The CDU has nonvolatile storage for up to 999 waypoints that are retained in memory only if entered on a stored flight plan. The ICAO identifiers stored in the database cannot be used for personalized waypoints.

Select the desired flight plan and position the cursor over the desired field. If necessary, refer to the procedure for creating a flight plan or modifying a flight plan.

(1) Creating Pilot Entered (Personalized) Waypoints.

1. Personalized identifier – Insert.
2. **ENTER** key – Press.
3. Latitude – Insert (N or S first, then degrees, minutes, and tenths of a minute).
4. **ENTER** key – Press.
5. Longitude – Insert (E or W first, then degrees, minutes, and tenths of a minute).
6. **ENTER** key – Press.

(2) Changing Pilot Entered (Personalized) Waypoints.

1. Personalized identifier – Insert.
2. **ENTER** key – Press. Pilot Entered WPT page will appear.
3. Line select key – Press to position the cursor over POS field.
4. **ENTER** key – Press.
5. Latitude – Insert (N or S first, then degrees, minutes, and tenths of a minute).
6. **ENTER** key – Press.
7. Longitude – Insert (E or W first, then degrees, minutes, and tenths of a minute).
8. **ENTER** key – Press.

NOTE

If an offset waypoint from a pilot entered waypoint is programmed, the RAD and DIS can be changed, but the coordinates cannot be manually inserted.

(3) Creating An Offset Waypoint. This procedure enables the system to create a waypoint at a given radial and distance from a known point. The known point (parent waypoint) may be any stored personalized or database waypoint.

NOTE

An offset waypoint is used in the same manner as any other waypoint.

The offset waypoint uses station declination, if available, or it uses the calculated magnetic variation of the parent waypoint. All points defined by a VHF navaid in the national/international airspace system are based on the VHF navaid station declination. Since the magnetic variation and station declination may not be the same at a given navaid, the calculated position and the defined position may differ.

An offset waypoint may be inserted in any waypoint ident field. The offset waypoint is retained in memory after system shutdown only if entered on a stored flight plan.

1. Cursor – Position over the desired waypoint IDENT field.

NOTE

More than one offset waypoint is allowed from one parent, using *, *1, *A1, etc., as identifying notation.

2. Parent waypoint identifier – Insert with an ***** following the entry.

NOTE

If field blinks, parent waypoint does not exist in CDU memory or in database and must be defined on a Flight Plan page.

3. **ENTER** key – Press.
4. Desired radial – Insert.
5. **ENTER** key – Press.
6. Desired distance – Insert (nautical miles and tenths of a nautical mile, 399.9 maximum).
7. **ENTER** key – Press.
8. POS coordinates – Verify for reasonability.
9. **ENTER** key – Press.

z. Database Update Procedures.

1. Aircraft power – Apply.
2. Current database update card – Insert into CDU.
3. **ON** Key – Press to turn on system.
4. To update, perform the following.

CAUTION

If an interruption of the update process is desired, remove the update disk. Do not turn off the power to stop the update.

a. **1** key – Press to select BEGIN UPDATE, if required. If update is not desired, press the **2** key to restart the system.

b. **ENTER** key – Press. The Updating Database page appears indicating database memory initialization.

NOTE

After initialization, the message COMPLETE and the changing update percentage appear indicating that the update is in progress.

If update is successful:

c. **ENTER** key - Press to restart navigation or turn system off.

If the database update fails, the error message FAILED will be displayed. Press the **1** key to retry the update or use the following procedure.

NOTE

Sometimes when a retry is initiated, a display such as CHECKING FOR DATABASE CARD may appear momentarily.

5. Update card – Remove.
6. System – Turn **OFF**.
7. Update card – Re-insert into CDU.
8. System – Turn **ON** and retry update using update procedure.
9. If the update card is the wrong database type, the message CARD INVALID will be displayed. Press the **1** key to retry update or use the following procedure.

a. Update card – Remove.

b. System – Turn **OFF**.

c. Update card – Verify and re-insert into CDU.

d. System – Turn **ON** and retry update using update procedure.

3A-29. GYRO MAGNETIC COMPASS SYSTEM.

a. Description. Two identical compass systems provide accurate directional information for the aircraft at all latitudes of the earth. For heading reference, two modes of operation are used: directional gyro (FREE) mode, or slaved (SLAVE) mode. In areas where magnetic references are reliable, the system is operated in the SLAVE mode. In this mode, the directional gyro is slaved to the magnetic flux valve that supplies magnetic reference for correction of the apparent drift of the gyro. In FREE mode, the system is operated as a free gyro. In this mode, latitude corrections are manually introduced using the **INCREASE/ DECREASE** switches. The slave/free mode is selected as desired using the **SLAVE/FREE** switches. Both compass systems (No. 1 and No. 2) are ac power dependent, and are powered by the selected inverter. Gyro compass 1 provides heading information for the pilot's HSI and copilot's RMI. Gyro compass 2 serves the copilot's HSI and the pilot's RMI.

b. Controls. The controls for the number 1 system are located to the left of the pilot's RMI and is controlled by two switches. The top switch is placarded **SLV** and **FREE** and selects the mode of operation. The bottom switch is Counter Clockwise, placarded (**CCW**) and Clockwise (**CW**) and is used to adjust the gyrocompass. A glass window with a needle inside is placarded **–** and **+** indicates adjustment.

c. Heading Miscompare Indicator. The EFIS EHSI will indicate which mode the directional gyro is operating in (SLAVE or FREE) and which system is providing the heading information, (No 1 or No 2). The yellow heading miscompare needle will appear anytime the No. 1 and No 2 heading differ by more than 6°.

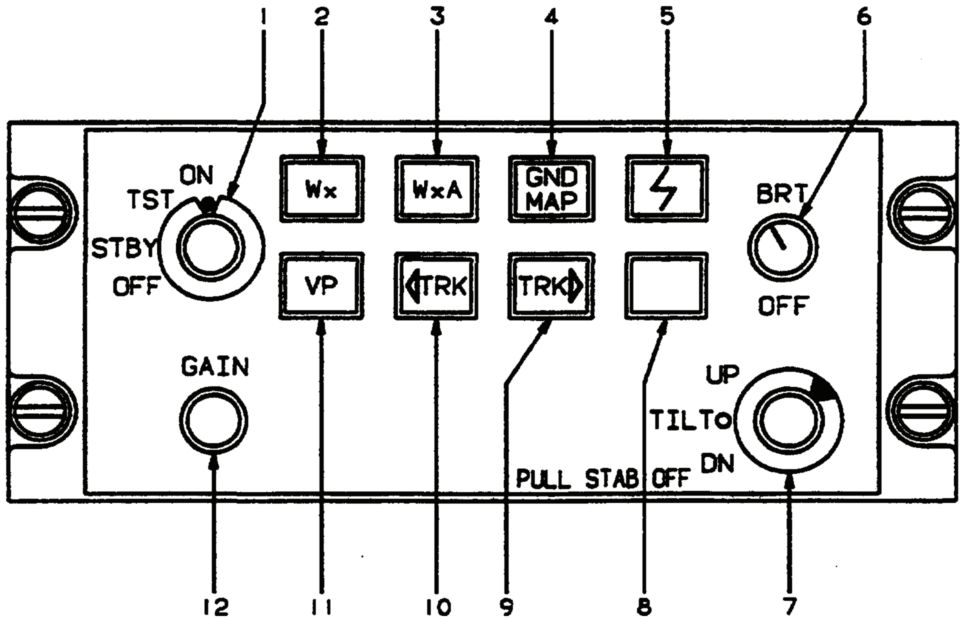
Section IV. RADAR AND TRANSPONDER

3A-30. RADAR AND TRANSPONDER EQUIPMENT GROUP DESCRIPTION.

The radar and transponder group consists of a weather radar, lightning sensor system, ground proximity altitude advisory system and transponder. The transponder and radar group includes an identification, position, emergency tracking system, and a radar and lightning sensor system to locate potentially dangerous weather areas.

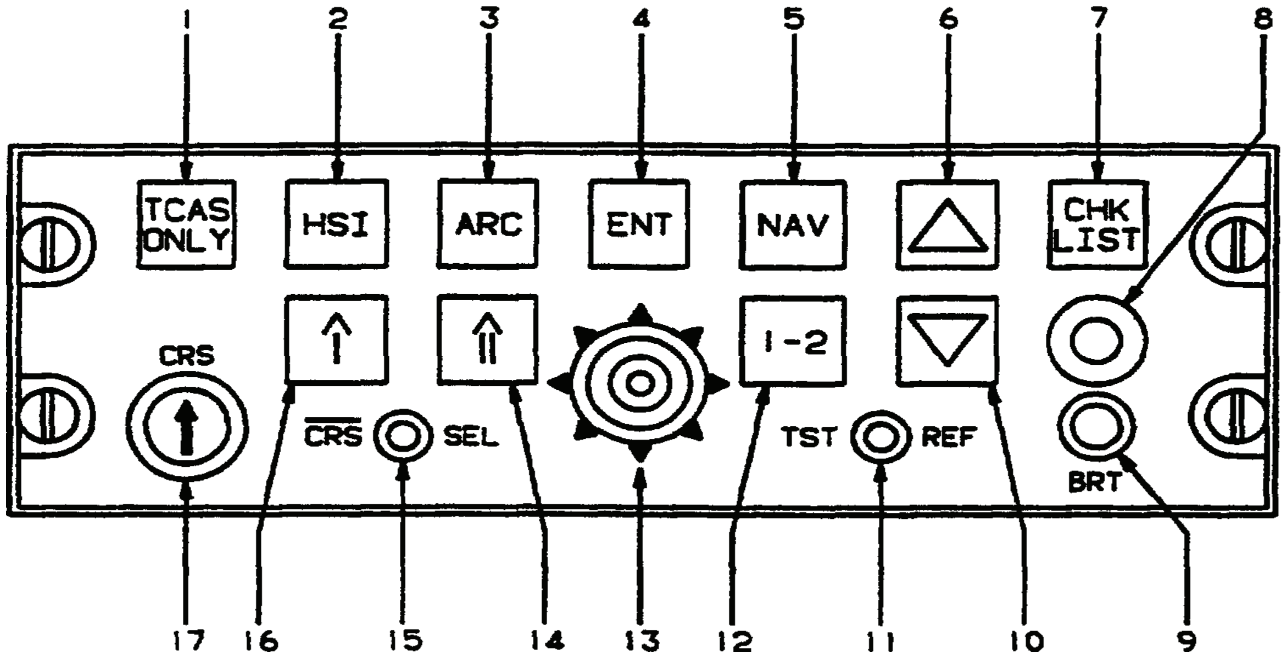
3A-31. WEATHER RADAR SYSTEM (RDS 84VP).

The weather radar system is a light weight, X-band digital radar with alphanumerics designed for weather detection and analysis and ground mapping. The radar system is controlled from the radar control panel, Figure 3A-65, located on the pedestal extension, Figure 2-11. Radar information is displayed on the pilot's and copilot's electronic horizontal situation indicator (EHSI) and on the multifunction display (MFD), Figure 3A-66.



1. Radar Mode Selector Switch
2. Weather Push-Button Mode Selector Switch
3. Weather Alert Push-Button Mode Selector Switch
4. Ground Map Push-Button Mode Selector Switch
5. Lightning Display Push-Button Mode Selector Switch
6. Display Brightness Control
7. Tilt/Stabilization Control
8. Not Used
9. Right Track Control
10. Left Track Control
11. Vertical Profile Push-Button Mode Selector Switch
12. Gain Control

Figure 3A-65. Weather Radar Control Panel



1. TCAS Only Push-Button Mode Selector Switch
2. HSI 360 Degree Push-Button Mode Selector Switch
3. HSI ARC Push-Button Mode Selector Switch
4. Enter Switch
5. Navigation Push-Button Selector Switch
6. Range Up Switch
7. Checklist Push-Button Switch
8. Data Input Jack
9. Brightness Control
10. Range Down Control
11. System/Reference Button Test Switch
12. Primary Navigation Sensor System Push-Button Selector Switch
13. Joystick
14. HSI Double Needle Bearing Pointer Source Push-Button Selector Switch
15. HSI Course Select Knob Activation Push-Button Switch
16. HSI Single Needle Bearing Pointer Source Push-Button Selector Switch
17. HSI Course Select Knob

Figure 3A-66. Multi-Function Display Control Unit

The primary purpose of the system is to detect storms along the flight path and give the pilot a color visual indication of their rainfall intensity. After proper evaluation, the pilot can chart a course to avoid these storm areas.

Figure 3A-67 depicts a typical EFIS weather test pattern (120 degree scan).

WARNING

The system performs only the functions of weather detection or ground mapping. It should not be used nor relied upon for proximity warning or anticollision protection.

Do not turn the radar on within 15 feet of containers of flammable or explosive material.

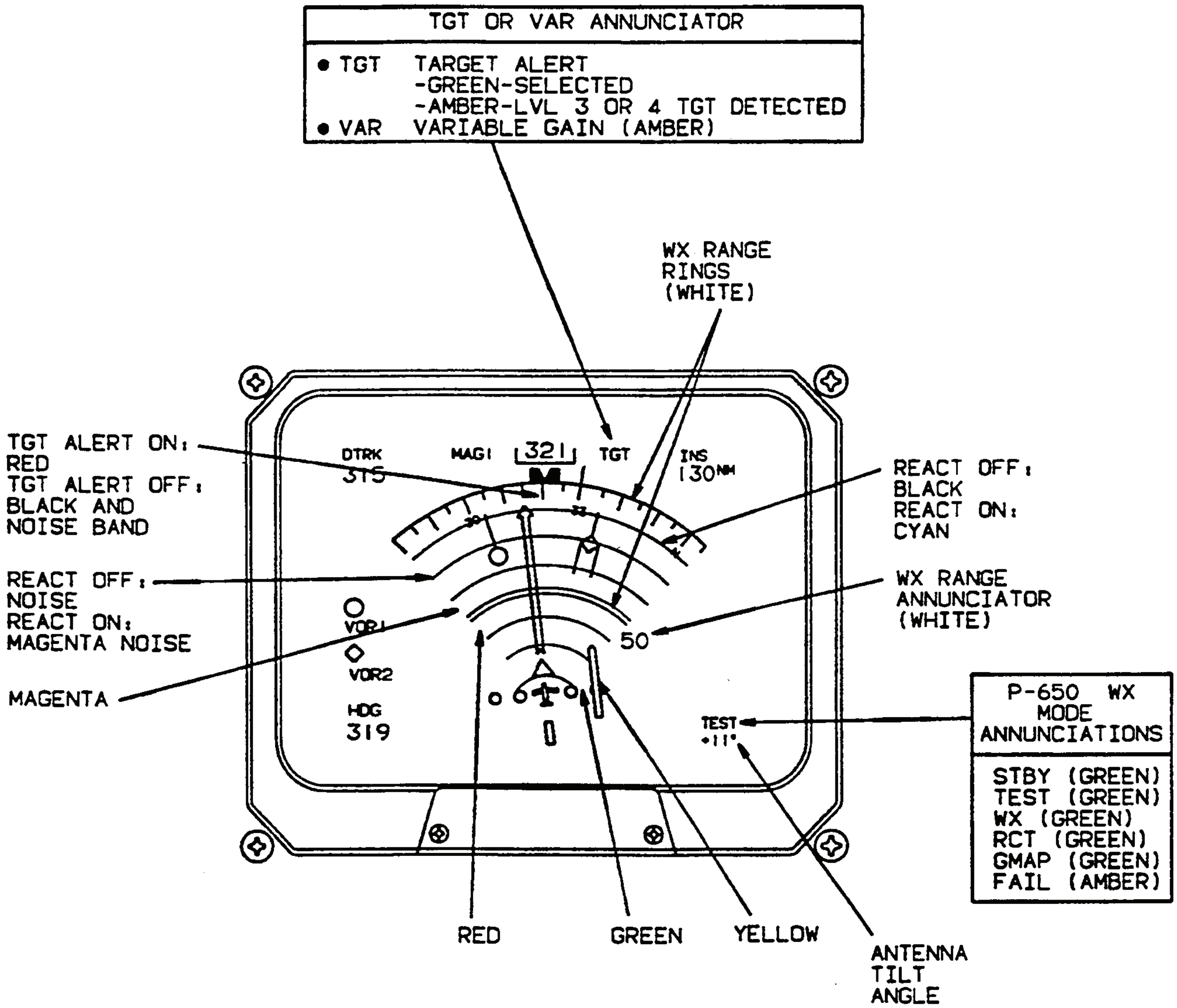


Figure 3A-67. EFIS Weather Test Pattern (Typical, 120-Degree Scan)

WARNING

The system always transmits in the ON mode. It does not transmit in the OFF, SBY, or TST modes but it does transmit in the NAV MAP mode.

Do not operate during refueling of aircraft or de-fueling operation within 100 feet (30 meters).

Do not operate if personnel are standing too close to the 240° forward sector of the aircraft. Refer to Figure 3A-68.

Operating personnel should be familiar with FAA AC 20-68B.

In the weather detection mode, precipitation intensity levels are displayed in four colors, contrasted against a deep black background. Areas of very heavy rainfall will appear in magenta, heavy rainfall in red, less severe in yellow, light rain in green, and little or no rainfall in black (background). The correlation of precipitation intensity and the color of displayed weather is shown in Table 3A-3.

Range marks with identifying numerics, displayed in white, are provided to facilitate evaluation of storm cells.

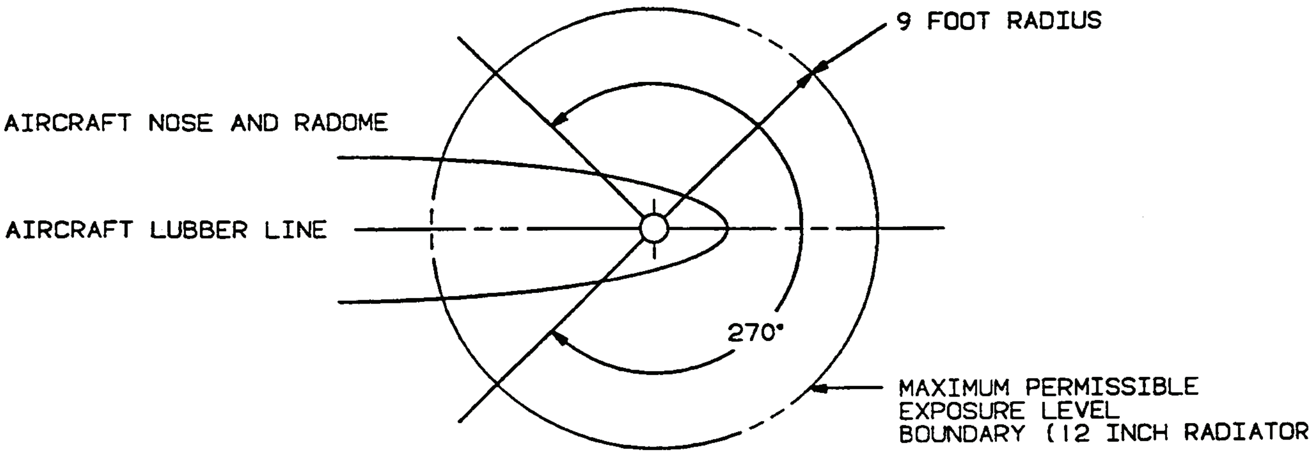


Figure 3A-68. Maximum Permissible Exposure Level

Table 3A-3. Video Integrated Processor VS Aircraft Radar Return Levels

DISPLAY LEVEL	RAINFALL RATE (MM/HR)	RAINFALL RATE (INCHES/HR)	VIDEO INTEGRATED PROCESSOR (VIP) CATEGORIZATIONS			MAXIMUM CALIBRATED RANGE (NM))
			STORM CATEGORY	VIP LEVEL	RAINFALL RATE (MM/HR) (INCHES/HR)	
4 (Magenta)	Greater than 52	Greater than 2.1	Extreme	6	Greater than 125 (5)	175
			Intense	5	50 – 125 (2 – 5)	
3 (Red)	Greater than 12 12 – 52	Greater than 0.5 0.5 – 2.1	Very Strong	4	25 – 50 (1 – 2)	175
			Strong	3	12 – 25 (0.5 – 1)	
2 (Yellow)	4 – 12	0.17 – 0.5	Moderate	2	2.5 – 12 (0.1 – 0.5)	175
1 (Green)	1 – 4	0.04 – 0.17	Weak	1	0.25 – 2.5 (0.01 – 0.1)	175
0 (Black)	Less than 1	Less than 0.04				—

Selection of the ground mapping (GMAP) function will cause system parameters to be optimized to improve resolution and enhance identification of small targets at short range. The reflected signal from ground surfaces will be displayed as magenta, yellow, or cyan (most to least reflective).

a. Radar Control Panel Controls, Indicators, and Functions.

(1) Radar Mode Selector Switch. The radar mode selector knob, placarded **OFF / STBY / TST / ON**, is used to select the operating condition of the radar system.

*(a) **OFF**.* The **OFF** position disables the ART (antenna, receiver, and transmitter) power supply. **OFF** is displayed below the NAV source annunciator on the radar mode line.

*(b) **STBY**.* After 30 seconds in the standby (STBY) mode the system is in a state of readiness. No radar transmission occurs, and the antenna is parked in the down position. STBY is displayed below the NAV source annunciator on the radar mode line, if a weather mode is selected.

*(c) **TST**.* Selecting the test (**TST**) position causes the test pattern to be displayed on the indicator, if a weather mode is selected. TEST will be displayed below the NAV source annunciator on the radar mode line.

NOTE

If ON is selected, the radar antenna, receiver, and transmitter (ART) is operational. However, if a weather radar mode is not selected for display, the ART will be placed in standby by the EFIS.

*(d) **ON**.* Selecting **ON** selects the condition of normal operation, allowing for weather detection or other modes of operation. Depending on the selected mode of operation, Wx, WxA, or MAP will be displayed below the NAV source annunciator on the radar mode line.

(2) Weather Push-Button Mode Selector Switch. The weather push-button mode selector switch, placarded **Wx**, is used to select the weather mode (Wx) when pressed. Wx will be displayed below the NAV source annunciator on the radar mode line, if a weather mode is selected.

(3) Weather Alert Push-Button Mode Selector Switch. The weather alert push-button mode selector switch, placarded **WxA**, is used to select the weather alert mode (WxA) when pressed. WxA will be displayed below the NAV source annunciator on the radar mode line, if a weather mode is selected.

(4) Ground Map Push-Button Mode Selector Switch. The ground map push-button mode selector switch, placarded **GND MAP**, is used to select the ground mapping mode when pressed. MAP will be displayed below the NAV source annunciator on the radar mode line. The color magenta is not active in the ground-mapping mode.

(5) Lightning Display Push-Button Mode Selector Switch. The lightning push-button mode selector switch, placarded with a lightning bolt, is used to enable the lightning display when pressed, if a weather mode is selected for display.

(6) Display Brightness Control. The display brightness control, placarded **BRT OFF**, is used to adjust display brightness.

(7) Tilt/Stabilization Control. The tilt/ stabilization control, placarded **TILT UP / DN**, **PULL STAB OFF**, permits manual adjustment of antenna tilt (15° up or down) to enable the pilot to analyze the weather presentation. The tilt angle is displayed below the NAV source annunciator on the radar tilt annunciator line.

Pulling out on the tilt selector knob will turn radar stabilization off. STAB OFF will appear on the radar fault/warning line displayed below the NAV source annunciator just under the antenna tilt annunciation line.

(8) Right And Left Track Controls. If the weather only mode is selected, pressing the **TRK** switch activates and slews a yellow dashed azimuth line. It also activates a digital display showing the number of degrees the azimuth line is located left or right from the nose of the aircraft. In any other map weather presentation, only the yellow dashed line will be displayed.

(a) Track Control Operation In Vertical Profile Mode. Prior to engaging VP, the appropriate button (left or right) is used to place the track line at the desired azimuth angle to be vertically scanned (sliced). When VP is engaged, the slice will be taken at the last position of the track line, whether it is visible or not. If the track line has not been selected after power has been applied to the system and VP is engaged, the slice will be taken at 0 degrees (directly in front of the aircraft).

When in VP mode, pressing the **TRK** switch will change the selected azimuth two degrees left or right, depending upon which button is pressed. Continuously holding the **TRK** button will result in the system slicing in 2-degree increments.

(9) Vertical Profile Push-Button Mode Selector Switch. Once the desired azimuth has been selected with the **TRK** switch, pressing the vertical profile push-button mode selector switch, placarded **VP**, selects the vertical profile mode of operation, and causes the vertical profile screen to appear. The weather mode of operation (Wx, WxA, or GND MAP) displayed in the lower left comer of the display will be the same as existed just prior to selecting VP. To select a different weather mode once in vertical profile,

select the desired mode (Wx, WxA, or GND MAP) by pressing the appropriate push-button switch.

The operation of scanning the antenna vertically is referred to as taking a vertical slice.

Once vertical profile has been selected, the desired profile azimuth angle may be changed in two-degree increments by pressing and holding the appropriate **TRK** switch. If the radar antenna is already profiling, the antenna will move in two-degree increments slicing in the direction determined by the **TRK** switch, or a WAIT annunciation will be displayed indicating that the radar antenna will perform the desired slicing function as soon as the antenna returns to the last selected profiling azimuth angle.

To terminate the vertical profile mode and return to the normal mode (horizontal scan), press the **VP** push-button switch. The radar system will retain its existing weather mode and return to horizontal scanning. A track line will be present on the screen for 15 seconds to indicate the location of the last profiling azimuth angle.

(10) Gain Control. The manual gain control knob becomes active when ground mapping mode (GND MAP) is selected. In all other modes, gain is internally set.

b. Weather Radar Normal Operation.

1. Radar mode selector switch – **TST**.

2. **TILT**/stabilization control – **UP** 7° (as shown on tilt indicator on display). Check for correct test pattern.

3. Radar mode selector switch – **TST** or **STBY**. Taxi to a clear area where there are no people, aircraft, vehicles, or metallic buildings within approximately 100 yards.

4. Radar mode selector switch – **ON**. Wx mode will be displayed in the 80-mile range. Any targets (weather or ground) will be displayed in green, yellow, red, or magenta.

5. Range switches (EFIS control panel) – Select 40 miles as maximum range.

6. **WxA** push-button mode selector switch – Press and observe that the magenta areas (if any) are flashing.

7. **TILT** control – Vary manually between **UP** 15° and **DN** 15° and observe that close-in ground clutter appears at lower settings and that any local rain appears at higher setting.

8. Radar mode selector switch – **TST** or **STBY** before taxi.

c. Weather Display Calibration. The radar display has been calibrated to show five levels of target intensity as shown in Table 3A-3. This table shows the approximate relationship of aircraft weather radar levels to the Video Integrated Processor (VIP) levels used by the National Weather Service. These levels are valid only when:

1. **Wx** or **WxA** mode is selected.

2. Displayed returns are within the STC range of the radar (approximately 40 miles).

3. The returns are beam filling.

4. There are no intervening radar returns.

d. Tilt Management. Effective antenna tilt management is the single-most important key for more informative weather radar displays. Three prime factors must be kept in mind for proper tilt management.

1. The earth's curvature must be considered in determining the location of the beam at long distances.

2. The center of the radar beam is referenced to the horizon by the aircraft's vertical reference system.

3. Adjusting the antenna tilt control will cause the center of the radar beam to scan above or below the plane of the attitude reference system.

A tilt setting that is too low will result in excessive ground or sea return while a setting that is too high can result in the radar beam passing above a weather target.

For detecting weather targets at long ranges and to allow adequate time for planning the proper avoidance path, the tilt angle should be set for a sprinkle of ground target returns on the display. By slowly raising the tilt angle, weather targets will emerge from the ground returns because of their height above the ground. In order to minimize ground returns when closely examining weather targets below the aircraft flight level, select the shortest range that allows full depiction of the area of interest.

e. En Route Weather Detection Operation. To set the antenna tilt to optimize the radar's ability to identify significant weather follow these steps:

1. **Wx** push-button mode selector switch – Press.

2. Range switches – Select 40 or 80 nautical mile range.

3. **TILT** control – Adjust down until entire display is filled with ground returns.

4. **TILT** control – Slowly raise antenna so that ground returns are pointed on about the outer one third of the indicator area.

5. Display – Watch strongest returns. If, as they are approached, they become weaker or fade out after working back inside the near limit of the general ground return pattern, they are probably ground returns or insignificant weather. If they continue strong after working down into the lower half of the indicator, you are approaching a hazardous storm or storms and should deviate.

6. Display – Examine the area behind strong targets. If radar shadows are detected you are approaching a hazardous storm or storms and should deviate. Regardless of the aircraft's altitude, if weather is being detected, move the antenna tilt control up and down in small increments until the return object is optimized. At that angle, the most active vertical level of the storm is being displayed.

f. Ground Mapping Mode. Ground mapping mode is selected by pressing the **GND MAP** push-button mode selector switch. The **TILT** control is then used to tilt the antenna down until the desired amount of terrain is displayed. The degree of tiltdown will depend upon the aircraft altitude and the selected range

g. Fault Monitoring. Critical functions in the receiver/transmitter/antenna are continuously monitored.

3A-32. LIGHTNING DETECTION SYSTEM (WX-1000E).

WARNING

The lightning detection system is to be used for hazardous weather avoidance, not weather penetration.

The lightning detection system is used to detect and locate areas of lightning activity within a 100 nautical mile radius around the aircraft. The system provides the operator with a visual display of the position and rate of occurrence of the lightning activity on the EHSI. The lightning detection system detects both visible and high energy invisible electromagnetic and electrostatic discharges (lightning) indicating areas of turbulent activity. After evaluating the lightning display, and its relation to precipitation as indicated by the weather radar display, the operator can effectively plan the proper course to avoid hazardous weather. The lightning detection system consists of a receiver/processor, an antenna, a mode selector pushbutton switch (located on the radar control panel), a control switch (located on the audio control panel), the pilot's and copilot's EHSI, and the multi-function display (MFD). The system is powered by a 2-ampere circuit breaker, placarded **STORMSCOPE**, located on the right sidewall circuit breaker panel, Figure 2-6. Because the system is a passive device (it does not transmit), it can be operated safely on the ground. Weather in all directions around the aircraft may be monitored, even before starting engines.

a. Lightning Detection System Controls and Functions.

(1) Lightning Detection System Control Switch. The lightning detection system control switch, placarded **STORMSCOPE OFF / ON / CLEAR**, located on the audio control panel, controls operation of the lightning detection system. The **OFF** and **ON** positions remove and apply power to the system. The **CLEAR** position is a momentary position that clears all thunderstorm information from the display.

(2) Lightning Display Push-Button Mode Selector Switch. The lightning display push-button mode selector switch, placarded with a lightning bolt, is located on the radar control panel. Pressing this switch selects or deselects lightning information for display on the EFIS or MFD.

3A-33. GROUND PROXIMITY ALTITUDE ADVISORY SYSTEM.

WARNING

The ground proximity altitude advisory will provide little, it any, warning for flight into precipitous terrain approaching a sheer wall if there is little gradually rising terrain before reaching the steep terrain.

a. Description. The Ground Proximity Altitude Advisory System (GPAAS) is provided to aid the flight crew in terrain avoidance.

The GPAAS is a completely automatic system (requiring no input from the crew) which continuously monitors the aircraft's flight path at altitudes of between 100 and 2000 feet Above Ground Level (AGL).

The GPAAS computer processes the data and, when conditions warrant, selects the appropriate digitized voice advisory/warning message from its memory. This message is then announced over the pilot's and copilot's audio systems. If the condition is not corrected, the GPAAS will rearm, and will again announce and repeat the warning if the condition recurs. The GPAAS computer remains ready to announce a different message during the intervals between repetitions. All messages are disabled below 100 feet AGL. The GPAAS system receives 28 Vdc power through a 1-ampere circuit breaker, placarded **GPAAS POWER**, located on the right sidewall circuit breaker panel, Figure 2-6.

(1) GPAAS Switch-Indicator Lights. A switch-indicator is located on the audio control panel. The upper half of the switch-indicator (yellow) is placarded **VOICE OFF**. The lower half is an indicator (red) only and is placarded **VA FAIL**.

Pressing the upper (**VOICE OFF**) switch-indicator disables the GPAAS advisory, and illuminates the VOICE OFF indicator light.

The **VA FAIL** annunciator light (red) will illuminate when the GPAAS fails.

(2) GPAAS Volume Control. A GPAAS volume control placarded **VOL,** located on the audio control panel, controls the audio volume of the GPAAS advisory/warning messages down to a certain minimum level.

(3) GPAAS Aural Warning Indications. The following is a list of aural indications. Due to the possibility of activating more than one condition at a time, a warning priority has been established. The highest priority message will be announced first. If a higher priority item is received after a message is started, voice annunciation of the higher priority message shall be announced after a lower priority message in progress at the end of the message segment. It will not stop in the middle of a word. On messages that are repeated three times at four-second intervals, the priority list will be scanned for higher priority messages and will insert them in the interval between the messages. The messages provided by the system are listed in descending order of priority as follows:

1. "Two Thousand" at 2000 feet AGL.
2. "One Thousand" at 1000 feet AGL.
3. "Nine Hundred" at 900 feet AGL.
4. "Eight Hundred" at 800 feet AGL.
5. "Seven Hundred" at 700 feet AGL.
6. "Six Hundred" at 600 feet AGL.
7. "Five Hundred" at 500 feet AGL.
8. "Check Gear" will be announced immediately after 500 foot announcement if gear is not down.
9. "Four Hundred" at 400 feet AGL.
10. "Check Gear" will be announced immediately after 400 foot announcement if gear is not down.
11. "Three Hundred" at 300 feet AGL.
12. "Check Gear" will be announced immediately after 300 foot announcement if gear is not down.
13. "Two Hundred" at 200 feet AGL.
14. "Check Gear" will be announced immediately after 200 foot announcement if gear is not down.
15. "One Hundred" at 100 feet AGL.
16. "Check Gear" will be announced immediately after 100 foot announcement if gear is not down.
17. "Minimum, Minimum" at decision height.

18. "Localizer" at 1.3 to 1.5 dots either side of center beam. Will be repeated three times at 4-second intervals.

19. "Glideslope" at 1.3 to 1.5 dots above or below center of beam. Will be repeated three times at 4-second intervals.

20. "Altitude, Altitude" at excessive deviation from altitude selected on the altitude alerter.

21. "Check Trim" when trim failure has occurred. Will be repeated three times at 4-second intervals.

22. "Autopilot" when autopilot has disconnected.

b. Normal Operation.

(1) Turn-on Procedure. The GPAAS is operable when the following conditions have been met.

1. **BATT** switch - **ON**.

2. **AVIONICS MASTER PWR** switch - **ON**.

3. **GPAAS POWER** circuit breaker – Set.

4. **RADIO ALTM** circuit breaker – Set.

5. **VA FAIL** annunciator light – Extinguished.

(2) GPAAS Ground Check.

1. GPAAS voice advisory **VOL** control – Full clockwise.

2. **VOICE OFF** switch-indicator – Extinguished.

3. Audio control panel – Set listening audio level.

4. **VA FAIL** annunciator light – Extinguished.

5. **DH** set knob – Set decision height to 200 feet on EADI.

6. **RALT TEST** switch – Press. "Minimum, Minimum" will be annunciated once followed by the illumination of the **VA FAIL** light.

c. GPAAS Modes of Operation. The GPAAS operates in the following modes of operation:

(1) Aural "Two Thousand" Advisory (Mode 1). The aural advisory "Two Thousand" indicates that the aircraft is at a radio altitude of 2000 feet above ground level. This advisory is canceled when valid information from the radio altimeter is lost, during climb, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(2) Hundred Foot Increment Aural Altitude Advisories (Mode 2). The aural advisories "One Thousand, Nine Hundred, Eight Hundred, Seven Hundred, Six Hundred, Four Hundred, Three Hundred, Two Hundred, One Hundred" indicate that the aircraft is at the associated radio altitude in feet above ground level. This advisory is canceled when valid information from the radio altimeter is lost, during climb, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(3) Aural "Localizer" Advisory (Mode 3). The aural advisory "localizer" indicates that the aircraft has deviated from the center of the localizer beam in excess of 1.3 to 1.5 dots. The localizer advisory is armed when a valid localizer signal is detected and the aircraft is below 1000 feet above ground level. It will be repeated no more than three times at 4-second intervals unless the aircraft is returned to less than 1.3 to 1.5 dots from the center of the localizer course. The localizer advisory is disabled when a valid localizer signal has been lost, during climb, below the decision height set on the radio altimeter, or if the navigation receiver is not tuned to a localizer frequency.

(4) Aural "Check Gear" Advisory (Mode 4). The aural advisory "Check Gear" indicates that the aircraft has descended to 500 feet AGL and the landing gear is not down. This advisory is repeated once at 100-foot intervals down to 100 feet AGL.

(5) Aural "Glideslope" Advisory (Mode 5). The aural advisory "Glideslope" indicates that the aircraft has exceeded 1.3 to 1.5 dots above or below the center of the glideslope beam. The glideslope advisory is armed when a valid glideslope signal is detected and the aircraft is below 1,000 feet AGL. It will be repeated no more than three times at 4-second intervals unless the aircraft is returned to less than 1.3 to 1.5 dots from the center of the beam. The glideslope advisory is disabled upon loss of a valid glideslope signal, during climb, on a localizer back course, below the decision height set on the radio altimeter or, if the navigation receiver is not \turned to

a localizer frequency. This advisory is inhibited by the weight on wheels strut switch.

(6) Aural Advisory "Minimum, Minimum" (Mode 6). The aural advisory "Minimum, Minimum" indicates that the aircraft is at the radio altitude selected by the crew with the radio altimeter DH set knob located, on the EFIS control panel. This advisory is canceled when valid information from the radio altimeter is lost, during climb, whenever the aircraft is above 1,000 feet AGL, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(7) Aural "Altitude, Altitude" Advisory (Mode 7). The aural advisory "Altitude, Altitude" indicates the approach to a pre-selected altitude as the aircraft reaches a point 1,000 feet from the selected altitude or, after reaching the selected altitude, when the aircraft deviates more than 250 feet from the selected altitude.

(8) Aural "Check Trim, Check Trim, Check Trim" Advisory. The aural advisory "Check Trim, Check Trim, Check Trim" indicates that the autopilot has had a trim failure.

(9) Aural "Autopilot" Advisory. The aural advisory "Autopilot" indicates that the autopilot has disengaged.

d. Emergency Procedures. If an emergency or malfunction makes it necessary to disable the GPAAS, pull the **GPAAS POWER** circuit breaker, located on the right sidewall circuit breaker panel, Figure 2-6. GPAAS audio may be turned off by pressing the **VOICE OFF** switch.

3A-34. TRANSPONDER (APX-100).

Refer to Chapter 3, Paragraph 3-5 for information on the APX-100 Transponder.

3A-35. TRANSPONDER (MST 67A).

a. Description. The transponder (MST 67A) responds to interrogation to allow the aircraft to be located in range and azimuth by a ground Air Traffic Control Radar Beacon System radar site. Upon receiving mode A or mode C interrogation the transponder transmits coded returns that identify the aircraft by code number and/or reports the altitude at which the aircraft is operating. This mode S transponder transmits random replies called squitter which include the unique mode S address assigned to the transponder at installation. The ATC mode S ground station receives this mode S reply and can selectively interrogate one specific address. The transponder receives on a frequency of 1030 megahertz and transmits coded reply pulses on a frequency of 1090 megahertz. The range of the transponder is line of sight. The transponder (MST 67A) is powered through a 3-ampere circuit breaker, placarded **XPNDR NO**. **2**, located on the right sidewall circuit breaker panel, Figure 2-6.

b. Transponder Control Unit Operating Controls (MST 67A). Refer to Figure 3A-69.

(1) Reply Indicator. The reply indicator is an **R** annunciator located in the upper left portion of the display. The reply indicator illuminates to indicate that the transponder is replying to ground interrogation. An interrogation that causes the **R** annunciator to illuminate will normally be processed with each sweep of the search radar that will normally be a 10 to 15 second interval.

(2) Ident Code/Flight Level Test Display.

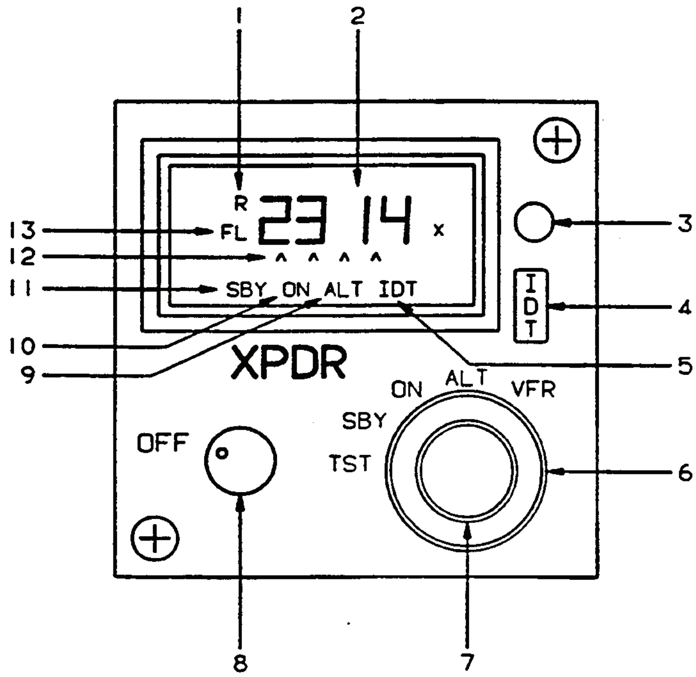
(3) Photocell. The built-in photocell automatically controls display brightness.

(4) Ident Switch. The ident switch, placarded **IDT**, when pressed momentarily then released, holds the ident reply for approximately 25 seconds to assure the proper reply within at least one radar sweep. During this time, the **IDT** annunciator will be illuminated on the transponder control unit display. The ident function may also be activated from switches mounted on each control wheel, placarded **ATC IDENT**.

(5) Ident Indicator. The ident indicator, placarded **IDT**, illuminates when the ident function has been activated by pressing the **IDT** switch on the transponder control panel or one of the control wheel ident switches placarded **ATC IDENT**.

(6) Function Switch. The function switch, placarded **TST / SBY / ON / ALT / VFR**, is used to select the operating mode of the transponder.

(a) ***TST****.* The test (**TST)** position of the function switch provides for a preflight or airborne check of transponder operation. This check is independent of any ground interrogation. Setting the function switch to **TST** should cause the reply (**R)** annunciator to flash and the flight level (**FL)** annunciator to illuminate. The transponder transmitter is inhibited during the test function. After 3 seconds, the unit will revert to the altitude (**ALT)** reporting mode.



1. **Reply Indicator**
2. **Ident Code/Flight Level/Test Display**
3. **Photocell**
4. **Ident Switch**
5. **Ident Indicator**
6. **Function Switch**
7. **Code Selector Switch**
8. **Power Switch**
9. **Altitude Mode Indicator**
10. **ON Indicator**
11. **Standby Indicator**
12. **Digit Select Cursor**
13. **Flight Level Indicator**

Figure 3A-69. Transponder Control Unit (MST 67A)

(b) ***SBY****.* Setting the function switch to **SBY** puts the transponder in the standby mode.

(c) ***ON****.* Setting the function switch to the **ON** position causes the transponder to provide identification and position information.

(d) ***ALT****.* Setting the function switch to the **ALT** position causes the transponder to provide identification, position, and altitude information.

(e) ***VFR****.* Setting the function switch to the **VFR** position will set the transponder code to 1200.

(7) Code Selector Switch. Momentarily pressing the code selector switch will cause the cursor to move to the right under the next digit of the transponder code display. Rotating the code selector switch clockwise or counterclockwise will change the numerical value of the selected digit.

(8) Power Switch. Turning the power switch clockwise from the **OFF** position applies electrical power to the transponder.

(9) Altitude Mode Indicator. Illumination of the altitude mode indicator, placarded **ALT**, indicates that the transponder is providing aircraft identification, position, and altitude information.

(10) ***ON*** *Indicator.* Illumination of the **ON** indicator indicates that the transponder is providing identification and position information but not altitude information.

(11) Standby Indicator. Illumination of the standby indicator, placarded **SBY**, indicates that the transponder is in the standby mode.

(12) Digit Select Cursor. The digit select cursor is used to select the digit that will be changed by rotating the code selector switch.

(13) Flight Level Indicator. The flight level indicator, placarded **FL**, indicates that mode S flight level information is being provided.

c. Transponder Operation.

1. **BATT** Switch – **ON**.
2. **AVIONICS MASTER PWR** Switch – **ON**.
3. Power Switch – **ON**.
4. Code Selector Switch – Set desired code.
5. Function Switch – **TST**. Check that all segments of the display illuminate for 2 seconds and that the squawk code display changes to flight level.
6. Function Switch – Select desired operating mode.

CHAPTER 3B
AVIONICS T3

Section I. GENERAL

3B-1. INTRODUCTION.

This chapter covers all avionics equipment installed in the C-12 T3 aircraft and provides a brief description of the equipment, the technical characteristics, and locations. If the item is common to all three aircraft, C-12R, C-12T3, and C-12F3, you will be referred to the appropriate paragraph in Chapter 3. For more detailed operational information, consult the vendor manuals that accompany the aircraft loose tools.

3B-2. AVIONICS EQUIPMENT CONFIGURATION.

The aircraft's avionics consist of three groups of electronic equipment. The communication group consists of the intercom system, AM/FM (V/UHF) SATCOM transceiver, two VHF-AM transceivers, HF transceiver OSA, an Emergency Locator Transmitter (ELT), and a cockpit voice and data recorder OSA. The navigation group consists of two VOR/localizer/glideslope/marker beacon receivers, Automatic Direction Finder (ADF) receiver, Distance Measuring Equipment (DME), Global Positioning Systems (GPS) FMS 1-FMS-800 and FMS 2-KLN 90B, radio altimeter, Electronic Flight Instrument System (EFIS), Automatic Flight Control System (AFCS), and a gyromagnetic compass system. The transponder and radar group consists of a weather radar system, transponder, Traffic Alert and Collision Avoidance System (TCAS), Lightning Detection System (Stormscope), and a Ground Collision Avoidance System (GCAS).

3B-3. POWER SOURCE.

a. DC Power. DC power for the avionics equipment is provided from four sources: the aircraft battery, left and right generators, and external power. Power is routed through two 50-ampere circuit breakers to the avionics power relay, which is controlled by the **AVIONICS MASTER PWR** switch located on the pilot's subpanel, Figure 2-5. Individual system circuit breakers are shown in Figure 2-6 and the associated avionics buses are shown in Figure 2-28 and Table 2-8.

(1) Avionics Master Power Switch. A switch placarded **AVIONICS MASTER PWR OFF**, located on the pilot's subpanel, controls power to the avionics buses.

(a) Off. In the down (off) position, power from the 5-ampere circuit breaker, placarded **AVIONICS MASTER**, located on the right sidewall circuit breaker panel, Figure 2-6, energizes the avionics relay, removing power from the avionics buses.

(b) On. With the switch in the UP (on) position, the avionics power relay is de-energized and power is applied to the avionics buses.

NOTE

If the AVIONICS MASTER PWR switch fails to operate, provide power to the individual avionics circuit breakers by pulling the 5-ampere circuit breaker, placarded AVIONICS MASTER, located on the right sidewall circuit breaker panel.

(2) DC Auxiliary Bus. DC power may be applied to an independent bus for isolated operation of the VHF COMM 1 radio, pilot's audio system, and instrument indirect lights. Use of the auxiliary bus is independent of the battery master switch position, but is controlled by a two position **ON / OFF** switch, placarded **DC AUX BUS,** located under the gang bar with the battery and generator switches. Placing this switch in the **ON** position will provide battery power to the auxiliary bus for operation of the previously mentioned equipment should an electrical emergency such as a dual bus failure occur in-flight, or if operation of the equipment is desired during pre/postflight operations.

b. Single-Phase AC Power. Two static inverters supply 400 Hz single-phase 115-volt and 26 Vac electrical power to the avionics equipment. The inverters are controlled by a switch placarded **INVERTER NO 1 / OFF / NO 2**, located on the pilot's subpanel.

Section II. COMMUNICATIONS

3B-4. COMMUNICATIONS EQUIPMENT GROUP DESCRIPTION.

The communications equipment group consists of an intercom system connected to a dual audio control panel serving both the pilot and copilot, which interfaces with VHF, SATCOM V/UHF, HF transceivers, and provides reception of audio from VOR, Localizer, Marker Beacon, DME and ADF receivers. Also included is the ELT, Voice Cockpit Recorder **OSA** , and Flight Data Recorder **OSA** .

3B-5. MICROPHONES, SWITCHES, AND JACKS.

a. Description. The communication group is comprised of an interphone system connected to a dual audio control panel, with separate controls for the pilot and copilot that interface with VHF SATCOM and HF communication units. HF radio, cockpit voice recorder, and flight data recorder equipment are not installed in ANG aircraft. Hand held boom and oxygen mask microphones can be utilized in the aircraft.

b. Controls and Functions.

(1) Control Wheel Microphone Switches. The pilot and copilot are each provided with control wheel microphone switches, placarded **MIC**, located behind the outboard handgrip of their respective control wheels, Figure 2-22. When the control wheel microphone switches are pressed, voice audio signals from the respective microphones are routed to the transmitter selected by the respective transmitter selector switch, located on the audio control panel, Figure 3B-1.

(2) Cockpit Floor Foot-Operated Microphone Switch (Optional). The copilot is provided with a foot-operated microphone switch, placarded **MIC**, located on the cockpit floor, forward of his respective seat position. Pressing the foot-operated microphone switch routes audio signals to the device selected by the copilot's transmitter selector switch located on the audio control panel.

*(3) **MIC NORMAL / OXYGEN MASK** Switch.* This switch is located on each pilot's respective outboard subpanel and selects microphone in **OXYGEN MASK** or **MIC NORMAL** selects boom or hand held microphone.

(4) Microphones Jacks. Two jacks are located in the side walls of the aircraft to the left of the pilot and to the right of the copilot. Hand held mike uses only the **MIC** jack. Boom mikes use both jacks, to include **MIC HEADSET** jack.

3B-6. AUDIO CONTROL PANELS.

a. Description. A dual audio control panel located on the instrument panel serves both the pilot and copilot. Its respective 2-ampere circuit breaker, placarded **PILOT AUDIO** and **COPILOT AUDIO**, located on the right sidewall circuit breaker panel powers each audio control panel.

b. Audio Control Panel Controls and Functions. Refer to Figure 3B-1.

*(1) Pilot's **COMM 1** Switch* – Selects No. 1 very high frequency receiver.

*(2) Pilot's **COMM 2** Switch* – Selects No. 2 very high frequency receiver.

*(3) Pilot's **HF** Switch* – Selects high frequency receiver.

*(4) Pilot's **MBND RADIO** Switch* – Selects ARC-210 radio transmitter.

*(5) Pilot's **NAV 1** Switch* – Selects No. 1 VOR audio.

*(6) Pilot's **NAV 2** Switch* – Selects No. 2 VOR audio.

*(7) Pilot's **MKR BCN 1** Switch* – Receives audio from No. 1 marker beacon.

*(8) Pilot's **MKR BCN 2** Switch* – Receives audio from No. 2 marker beacon.

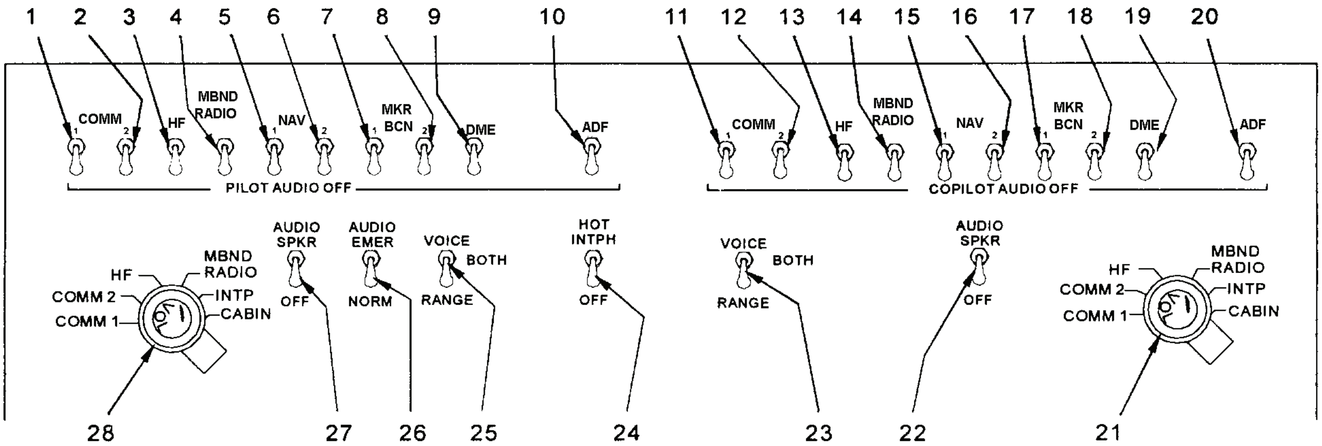
*(9) Pilot's **DME** Switch* – Receives DME audio.

*(10) Pilot's **ADF** Switch* – Receives ADF audio.

*(11) Copilot's **COMM 1** Switch* – Selects No. 1 very high frequency receiver.

*(12) Copilot's **COMM 2** Switch* – Selects No. 2 very high frequency receiver.

*(13) Copilot's **HF** Switch* – Selects high frequency receiver.



1. Pilot's COMM 1 Switch
2. Pilot's COMM 2 Switch
3. Pilot's HF Switch
4. Pilot's MBND Radio
5. Pilot's NAV 1 Switch
6. Pilot's NAV 2 Switch
7. Pilot's MKR BCN 1 Switch
8. Pilot's MKR BCN 2 Switch
9. Pilot's DME Switch
10. Pilot's ADF Switch
11. Copilot's COMM 1 Switch
12. Copilot's COMM 2 Switch
13. Copilot's HF Switch
14. Copilot's MBND Radio
15. Copilot's NAV 1 Switch
16. Copilot's NAV 2 Switch
17. Copilot's MKR BCN 1 Switch
18. Copilot's MKR BCN 2 Switch
19. Copilot's DME Switch
20. Copilot's ADF Switch
21. Copilot's Transmitter Selector
22. Copilot's AUDIO SPKR / OFF Switch
23. Copilot's VOICE / BOTH / RANGE Switch
24. HOT INTPH / OFF Switch
25. Pilot's VOICE / BOTH / RANGE Switch
26. AUDIO EMER / NORM Switch
27. Pilot's AUDIO SPKR / OFF Switch
28. Pilot's Transmitter Selector

Figure 3B-1. Dual Audio Control Panel

(14) Copilot's ***MBND RADIO*** *Switch* – Selects ARC-210 Radio transmitter.

(15) Copilot's ***NAV 1*** *Switch* – Selects No. 1 VOR audio.

(16) Copilot's ***NAV 2*** *Switch* – Selects No. 2 VOR audio.

(17) Copilot's ***MKR BCN 1*** *Switch* – Receives audio from No. 1 marker beacon.

(18) Copilot's ***MKR BCN 2*** *Switch* – Receives audio from No. 2 marker beacon.

(19) Copilot's ***DME*** *Switch* – Receives DME audio.

(20) Copilot's ***ADF*** *Switch* – Receives ADF audio.

(21) Copilot's Transmitter Selector – Select **COMM 1, COMM 2, HF, MBND RADIO, INTP**, or **CABIN**.

(22) Copilot's ***AUDIO SPKR/OFF*** *Speaker Switch* – Routes audio to overhead speakers.

(23) Copilot's ***VOICE / BOTH / RANGE*** *Switch.*

(a) ***VOICE*** – Kills range; allows voice.

(b) ***BOTH*** – Allows both voice and range.

(c) ***RANGE*** – Kills voice; allows 1020 Hz range tone.

(24) ***HOT INTPH / OFF*** *Switch* – Allows interphone communication between pilot and copilot without keying the **MIC** button.

(25) Pilot's ***VOICE / BOTH / RANGE*** *Switch.*

(a) ***VOICE*** – Kills range; allows voice.

(b) ***BOTH*** – Allows both voice and range.

(c) ***RANGE*** – Kills voice, allows 1020 Hz range tone.

(26) ***AUDIO EMER / NORM*** *Switch*.

(a) ***EMER*** – Allows reception of all audio in headphones in the event of failure of audio amplifier.

(b) ***NORM*** – Allows normal operation of the audio amplifier.

(27) Pilot's ***AUDIO SPKR / OFF*** *Switch* – Routes audio to overhead speakers.

(28) Pilot's Transmitter Selector – Select **COMM 1**, **COMM 2**, **HF**, **MBND RADIO**, **INTP**, or **CABIN**.

3B-7. VHF COMMUNICATIONS COMM 1 AND COMM 2.

Refer to Chapter 3, Paragraph 3-4, for information on the VHF Communication Radios.

3B-8. HF COMMUNICATIONS OSA .

Refer to Chapter 3, Paragraph 3-3, for HF descriptions and operation information.

3B-9. SATCOM COMMUNICATIONS.

a. Description. The AN/ARC-210 SATCOM Radio is installed in the C-12T3 for V/UHF communication.

b. Power to the AN/ARC-210 is provided through a 7½-ampere circuit breaker, placarded **MBND RADIO**, located on the right hand circuit panel.

c. Control and Operations. Control of the ARC-210 is through the FMS-800 CDU. Refer to Paragraph 3B-19t for control and operating procedures.

3B-10. EMERGENCY LOCATOR TRANSMITTER.

a. Description. An automatic or manually activated Emergency Locator Transmitter (ELT) is located in the right side of the fuselage at approximately FS 340.00. The associated antenna is mounted on top of the aft fuselage at approximately the same location. An access hole with spring-loaded cover is located in the fuselage skin adjacent to the transmitter, enabling a downed pilot to manually initiate or terminate operation, or reset the ELT to an armed mode. The transmitter contains an impact G switch that automatically activates the transmitter following a 3 G to 7 G impact along the flight axis of the aircraft. When activated, the ELT will radiate omnidirectional RF signals on the international distress frequencies of 121.5 MHz and 243.0 MHz. The radiated signal is modulated with an audio swept tone. Internal batteries provide transmitter operation for a minimum of 48 hours.

b. Switches and Functions.

(1) ***ARM***. Establishes readiness state to start automatic emergency signal transmissions when the force of impact exceeds a preset threshold.

(2) ***ON***. Turns set on initiating emergency signal transmissions.

(3) ***OFF***. Turns set off.

3B-11. COCKPIT VOICE RECORDER SYSTEM OSA.

a. Introduction. The Cockpit Voice Recorder (CVR) system records all voice signals on a continuous-loop magnetic tape for a maximum period of 30 minutes. Voice recordings in excess of 30 minutes are automatically erased. The voice inputs may be either transmitted or received signals originating from the aircraft communications system or the remotely mounted cockpit area microphone mounted in the glareshield. The CVR system is a modular system comprised of three modules, the recorder, the control unit, and a remote microphone. The recorder is a vibrator mounted unit housed in an international orange case located in the unpressurized aft fuselage area. The recorder contains the recording unit and associated electronics. An impact switch, mounted in the aft avionics compartment, controls power to the voice recorder. If the impact switch is subjected to a 2.5 G shock, the recorder is electrically disconnected to prevent further recording and erasure or voice communications. A red light located on the impact switch case when illuminated indicates the switch has been actuated. Pressing the reset button located adjacent to the impact switch light causes the light to extinguish and restores power to the voice recorder. The control unit is located on the extended pedestal, and houses the microphone preamplifier, test switch, erase switch and a meter. The remote microphone module is located in the glareshield outboard of the Warning Annunciator panel. The CVR system receives 115 Vac power through a 1-ampere circuit breaker, placarded **RECORDER POWER /**

VOICE, located on the copilot's sidewall circuit breaker panel.

b. Controls, Indicators, and Functions. Refer to Figure 3B-2.

(1) Go-No-Go Self-Test Meter. Provides visual indication of Go-No-Go during preflight self-test.

(2) ***TEST*** *Switch.* Allows testing of recording mode. Meter indicates self-test Go/No-Go indication and an aural tone is produced through headset jack.

(3) ***ERASE*** *Switch.* Permits erasure of recording at end of flight. To prevent accidental erasure, the switch must be held for 2 seconds with the landing gear extended and the weight of the aircraft on the landing gear and the parking brake set.

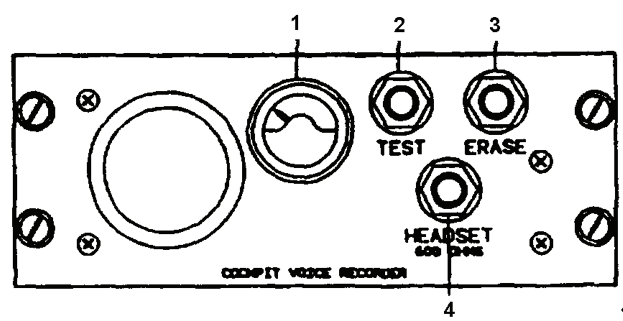
(4) ***HEADSET*** *Jack.* Allows monitoring of voice recordings, after a 2-second delay, and an aural tone during self-test.

3B-12. FLIGHT DATA RECORDER OSA .

a. Description. The digital flight data recorder system (referred to herein as a crash data recorder) continuously records flight data inputs for the last 25 hours of flight. The flight data parameters recorded are heading, altitude, vertical acceleration, and airspeed. The data is recorded on a continuous loop, ¼ inch, self-lubricating magnetic tape bundle. The tape is drawn out of the hub and returned to the supply reel at the outer periphery of the bundle after having passed the write and read heads. The tape capsule is protected by an inner aluminum casing, an isothermal shield, an outer stainless steel casing, and an outside steel dust cover. The construction of the cases provide survivability assurance, while the isothermal shield provides protection from temperatures. There are no pilot accessible controls or switches associated with the recorder. Its operation is completely automatic. An impact switch, mounted in the aft avionics compartment, controls power to the recorder. If the impact switch is subjected to a 2.5 G shock, the recorder is electrically disconnected to prevent further recording and erasure. A red light located on the impact switch case when illuminated indicates the switch has been actuated. Pressing the reset button located adjacent to the impact switch light causes the light to extinguish and restores power to the recorder.

b. Power. The recorder system is powered through a 1-ampere 115 Vac circuit breaker, placarded **RECORDER POWER / FLT** located on the copilot's sidewall circuit breaker panel.

c. Underwater Locator. A battery powered, acoustic underwater locator beacon assembly is mounted on the front panel of the crash data recorder. The unit consists of a self-contained battery, an electronic module, and a transducer. The battery is shock mounted and is separated from the electronic module by a bulkhead in the case. The beacon (pinger) radiates a pulsed acoustic signal into the surrounding water upon activation of its water-sensitive switch, and will activate automatically on submersion in salt or fresh water with an operating life expectancy of 30 days to a depth of 20,000 feet.



1. Meter
2. TEST Switch
3. ERASE Switch
4. HEADSET Jack

Figure 3B-2. Cockpit Voice Recorder Control Unit OSA

Section III. NAVIGATION

3B-13. NAVIGATION EQUIPMENT GROUP.

The navigation equipment group provides the pilot and copilot with instrumentation required to establish and maintain an accurate flight course and position, and to make an instrument approach under Instrument Meteorological Conditions (IMC). The navigation configuration includes equipment for determining attitude, position, destination range; and bearing, heading reference, and ground speed.

3B-14. FLIGHT DISPLAY SYSTEM (FDS-255).

a. System Overview. The Flight Display System (FDS-255), is a replacement for existing electromechanical Attitude Direction Indicator (ADI) and Horizontal Situation Indicator (HSI) flight instruments.

The top and bottom displays are physically identical. The top display is configured as an

Electronic Attitude Direction Indicator (EADI) and the bottom display is configured as an Electronic Horizontal Situation Indicator (EHSI).

The MFD provides all of the internal diagnostics, data processing, and hardware configuration to provide the following display modes:

(1) HSI. Full compass rose (360°) or HSI ARC which includes course needles, a bearing needle, heading bug, etc.

(2) Missed Approach Point. A centered 360° Missed Approach Point (MAP) or an expanded compass rose segment (80°). Both of these modes include the current set of waypoints and course legs.

(3) ADI. Provides aircraft attitude pitch and roll, lateral deviation, and vertical deviation.

(4) Primary Flight Display (PFD). ADI and HSI combined on one display.

(5) Diagnostics. Provides Multi Functional Display (MFD) status pages.

b. External Aircraft Controls.

*(1) **ALT ADI** (Reversionary) Switch.* The **ALT ADI** (reversionary) switches are external push button switches allowing the operator to place the EADI information on the bottom display. The pilot's switch is located on the lower left portion of the dash panel under the **EFIS1** and **2 POWER** switches. The copilot's switch is located on the lower right portion of the dash panel under the Vertical Speed Indicator. The switch has two positions: normal (off, non-illuminated) and reversionary (on, illuminated). In the normal position the top display is an EADI and the bottom display is an EHSI. In the reversionary position the top display blanks and the bottom display becomes a PFD (Primary Flight Display).

*(2) **OBS / LEG** Switch*. The **OBS / LEG** switch places the FMS 2, KLN 90B in either LEG or OBS mode. The **OBS / LEG** switch is located on the top center portion of the dash panel to the right of the altitude select panel. While in LEG mode the KLN 90B continuously updates the desired course in order to fly a great circle route between the FROM and TO waypoints. If the leg selection is made and FMS 2 is selected as the primary navigation source, the digital course label displays DTK. While in OBS mode the pilot's MFD control panel updates the course and sends the manually selected course to the KLN 90B. If the OBS selection is made and FMS 2 KLN 90B is selected as the course source, the digital course label displays CRS and reflects the pilot's control panel course selection.

*(3) **EFIS #1** and **EFIS #2 Power** Switch*. The **EFIS #1 / EFIS #2** power switch is a push-button switch located on the lower left side of the dash panel beneath the Turn and Slip Indicator. Power is applied to the pilot's display via **EFIS #1** switch and power is applied to the copilot's display via **EFIS #2** switch.

*(4) **DME** Hold Switch.* The **DME** hold switch enables the DME hold feature of VOR 1. The **DME** hold switch is located on the CTL-32 NAV Control Head. The pilot's MFD monitors the **DME** hold switch and annunciates its position.

*(5) **COMPASS 1** and **COMPASS 2** Switches*. The **COMPASS 1** switch is located on the lower left side of the dash panel under the **EFIS #1 / EFIS #2** switch. The **COMPASS 2** switch is located on the lower right side of the dash panel under the Vertical Speed Indicator. The compass switches consist of a gyro **FREE / SLAVE** switch and an **INCREASE / DECREASE** (slew) switch. Selecting **FREE** on the **FREE / SLAVE** switch disengages the gyro and allows manual slewing of the compass card via the **INCREASE / DECREASE** Switch. When **FREE** is selected, heading validity is ignored. The **COMPASS 1** switches control the pilot side compass card and the **COMPASS 2** switches control the copilot side compass card. The MFD does not interface with the slew Switches and only annunciates the state of the **FREE / SLAVE** Switch.

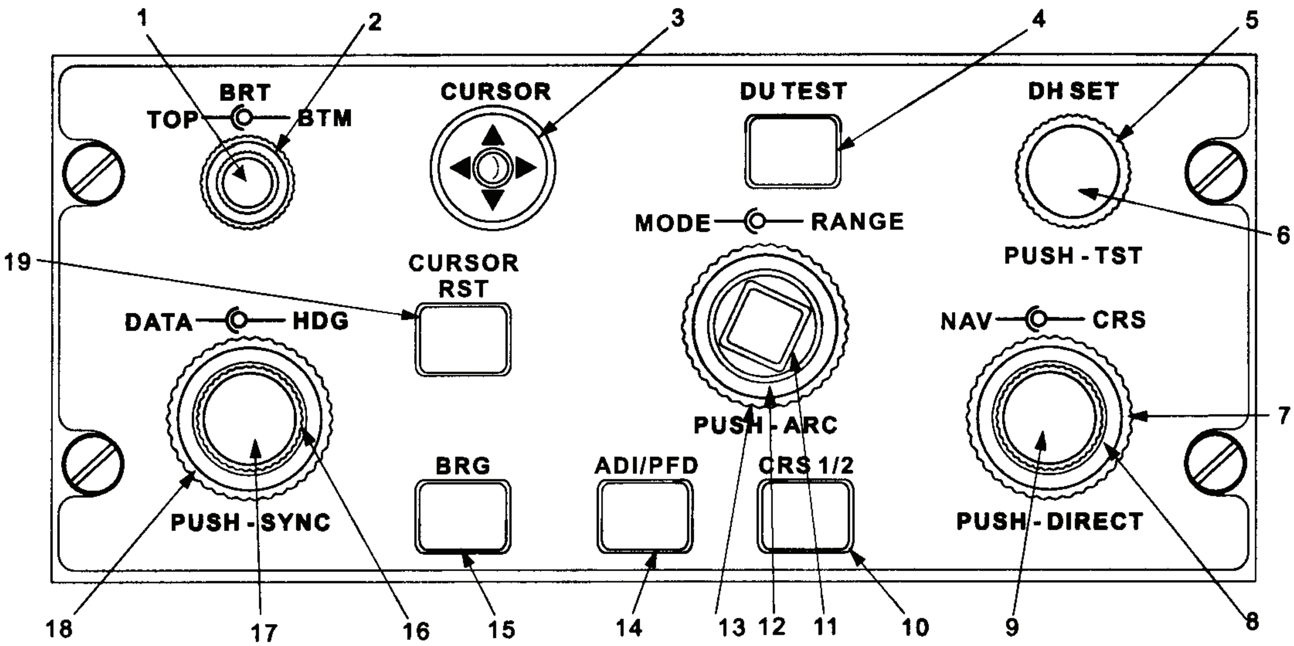
c. Display Control Panel.

(1) MFD Control Panel. The MFD Control Panel provides integrated display management via the controls shown in Figure 3B-3. Unless otherwise noted the pilot's control panel drives the pilot's displays, and the copilot's control panel drives the copilot's displays. The pilot can select PFD on the display control panel when in the reversionary mode. This makes the bottom display a PFD without some of the functions.

WARNING

Whenever either display fails it is probable that functions of that display will also fail.

(2) Display Control Panel Controls and Functions. Listed below are the controls found on the Control Panel and their corresponding functions. Refer to Figure 3B-3.



1. **EHSI Brightness Control**
2. **EADI Brightness Control**
3. **CURSOR**
4. **MFD Test Button**
5. **DH Setting**
6. **Radio Altitude Test**
7. **Course Source Selector**
8. **Course Selector**
9. **Course Sync Button**
10. **CRS 1/2 Button**
11. **ARC Button**
12. **Range Button**
13. **MODE Selector**
14. **ADI / PFD Button**
15. **Bearing Source Selector**
16. **HDG Selector**
17. **HDG SYNC Button**
18. **DATA Selector**
19. **CURSOR Reset**

Figure 3B-3. Multi-Functional Display Control Panel

(a) EHSI ***BRT*** *(Brightness) Control*. The brightness control consists of two concentric knobs. The inner (top) knob controls the brightness of the EHSI (bottom MFD). Full counterclockwise rotation of the brightness knob provides the minimum brightness level and full clockwise rotation is interpreted as the maximum brightness setting.

(b) EADI ***BRT*** *(Brightness) Control*. The brightness control consists of two concentric knobs. The outer (bottom) knob controls the brightness of the EADI (top MFD). Full counterclockwise rotation of the brightness knob provides the minimum brightness level and full clockwise rotation is interpreted as the maximum brightness setting.

(c) ***CURSOR***. The **CURSOR** control operates on the Map and Map ARC displays. The **CURSOR** joystick moves a cross-hair symbol in XY motion. The bearing and distance to the cursor symbol is displayed next to the aircraft symbol. The absolute bearing is in degrees. Any time the cursor is active the MFD displays its absolute bearing (north referenced azimuth) and range in degrees/nm (for example - 273/22) next to the cursor. A dashed line connects the aircraft symbol and the cursor symbol. After 30 seconds of no cursor movement, the cursor bearing and distance information is removed from the display and the cursor location is reset to a bearing and distance of zero. The MFD will reset the cursor back to the aircraft symbol when cross hair time out occurs, 30 seconds, when the **CURSOR RST** button is pressed, or when different page is selected. The bearing and distance of the cursor location is sent out of the pilot's bottom MFD to FMS 1. To activate the MARK function, align the cursor crosshairs over a desired location such as a waypoint and press the **MARK** button on the FMS-800 control.

(d) ***DU TEST*** *Button*. Pressing the **DU TEST** button places both onside MFD's into diagnostics mode when the current display page is not a diagnostic page and the aircraft is on the ground.

The diagnostics page consists of MFD status information shown as a result of a Built-In-Test (BIT). The diagnostic display page is only active while the aircraft is on the ground and the Weight On Wheels (WOW) discrete is set.

Perform the following procedures to select the first **DU TEST** page (other pages are for maint.).

1. Press the **DU TEST** button on the control panel. Ensure display install is correct for the aircraft.

2. Press the **CRS** button on the control panel to exit **DU TEST**.

(e) ***DH SET*** *(Decision Height) Setting*. The **DH** knob rotates and has a center push button. The **DH SET** knob is used to set the decision height. Clockwise rotation increases the decision height. The decision height is displayed in green following the letters DH in the lower right corner of the ADI. When the radio altitude is at or below the DH setting, the yellow letters DH appear in the right center portion of the ADI or PFD display and a "Minimum" aural annunciation is sounded. Once the DH annunciation appears, it is removed from the display when the radio altitude climbs at least 25 feet above the decision height. If the radio altimeter system fails, the decision height annunciator is removed and the radio altitude flag appears.

(f) ***DH SET/TEST***. The **DH SET/TEST** knob is a radio altitude test button. Pushing the knob causes the radio altimeter to go into test. While the radio altimeter is in test, the digital readout remains displayed, even when the radio altimeter validity is flagged.

(g) ***NAV/CRS*** *(Source) Selector*. The **NAV/CRS** select knob is a dual concentric knob with a center push button. The outside knob selects the active course sources. The selections are FMS or VOR. The selector switch is knob that when rotated cycles between the sources. Used in conjunction with the **CRS 1/2** button, the Nav sources are switched between all navigation sources (i.e., FMS 1/FMS 2 or VOR1/VOR 2).

(h) ***NAV/CRS*** *(Course) Selector*. The inner knob on the **NAV/CRS** Control selects the desired course for the active course source. When the knob is moved slowly, a single click will result in a 1° course change. If the knob is rotated quickly, the course setting changes numerous degrees per click.

If the **OBS / LEG** switch is in the OBS mode, the pilot's course setting knob will control the course for the KLN 90B. The bottom MFD on the pilot's side provides the selected course to the KLN 90B when it is in the OBS mode.

(i) Course Sync Button. The center push button on the course source control is a **CRS** sync button. Pressing the **CRS** sync (Direct-To) button for a VOR (VHF Omni Range) course source sets the active source's course to the source's bearing.

(j) ***CRS 1/2*** *Button*. The **CRS 1/2** button toggles the selected navigation course (selected by the NAV Source Control) between #1 and #2 navs.

(k) ***ARC*** *Button*. The center push button on the mode selector is an **ARC** button. Pressing the **ARC** button toggles the EHSI display between ARC and 360° as follows:

1. HSI Mode. Full 360° compass rose or HSI ARC 80° compass rose.

2. MAP Mode. Map 80° arc or 360° Map with full compass.

(l) ***RANGE*** *Selector*. The inner knob on the **MODE-RANGE** selects the range for displays when a Map mode has been selected. Available ranges are 2.5, 5, 10, 20, 40, 80, 160, 320, and 640 nm. Range information is stored in the control panel and defaults to the last selected value at power up.

(m) ***MODE*** *Selector*. The outer knob on the **MODE-RANGE** selects between HSI and map modes.

(n) ***ADI / PFD*** *Button*. The **ADI / PFD** button on the display control panel is a reversionary mode and toggles the EADI between a basic EADI display and a PFD.

(o) ***BRG*** *(Bearing) Source Selector*. The bearing (**BRG**) button selects the navigation source to be displayed on the EHSI as the bearing source. The aircraft bearing selections are **OFF**, **FMS 1**, **FMS 2**, **VOR 1**, **VOR 2**, and **ADF 1**. If the selected navigational source is providing reliable course guidance, the associated bearing pointer will also be displayed.

(p) ***HDG*** *(Heading) Selector*. The inner knob of the **DATA-HDG** selector is used to position the heading bug. When the heading knob is moved slowly, a single click results in one degree heading changes. If the knob is rotated quickly, the heading setting changes numerous degrees per click.

(q) ***HDG SYNC*** *Button*. The center push button on the **DATA-HDG** is a **HDG SYNC** selection. Momentarily pressing the **HDG SYNC** button will automatically slew the selected heading bug to the lubber line. When FMS 1 is the selected navigation source and the **HDG SYNC** button is pressed and held for 2 seconds or more, an FMS heading bug appears on the MFD and syncs to the selected heading. Then, the navigation source label FMS changes to FHDG.

(r) ***DATA*** *Selector*. The **DATA-HDG** is a dual concentric selector with a center push button. The outer **DATA** knob provides sequential selection of FMS data to include groundspeed (GS), True Airspeed (TAS), time to go to next waypoint (TTG), Elapsed Time (ET) from WOW, and OFF-no data displayed.

(s) ***CURSOR RST*** *(Reset)*. The cursor reset button resets the cursor to the aircraft symbol.

3B-15. ELECTRONIC ATTITUDE DIRECTOR INDICATOR.

a. Description. The Electronic Attitude Director Indicator (EADI), Figure 3B-4, is an instrument whose primary function is to display the aircraft's current attitude. It combines the functions of many electromechanical indicators into a single electronic display. This display consists of the Attitude Display Indicator (ADI) display and the reversionary Primary Flight Display (PFD). The normal and default (on power-up) display format on the EADI is the ADI format.

The ADI presents attitude, comparator warning annunciations, decision height setting, and rate of turn indicator. Other parameters that are displayed as a function of pilot selection are DH annunciation, Radio Altitude, Rising Runway, Vertical Deviation (GS or VNAV), Speed Deviation, Flight Director Command Bars (V Bars), Aircraft Symbol, Lateral Deviation, Marker Beacons, Flight Director Annunciations, and Course Source (LOC, VOR, or FMS).

b. ADI Display Symbology.

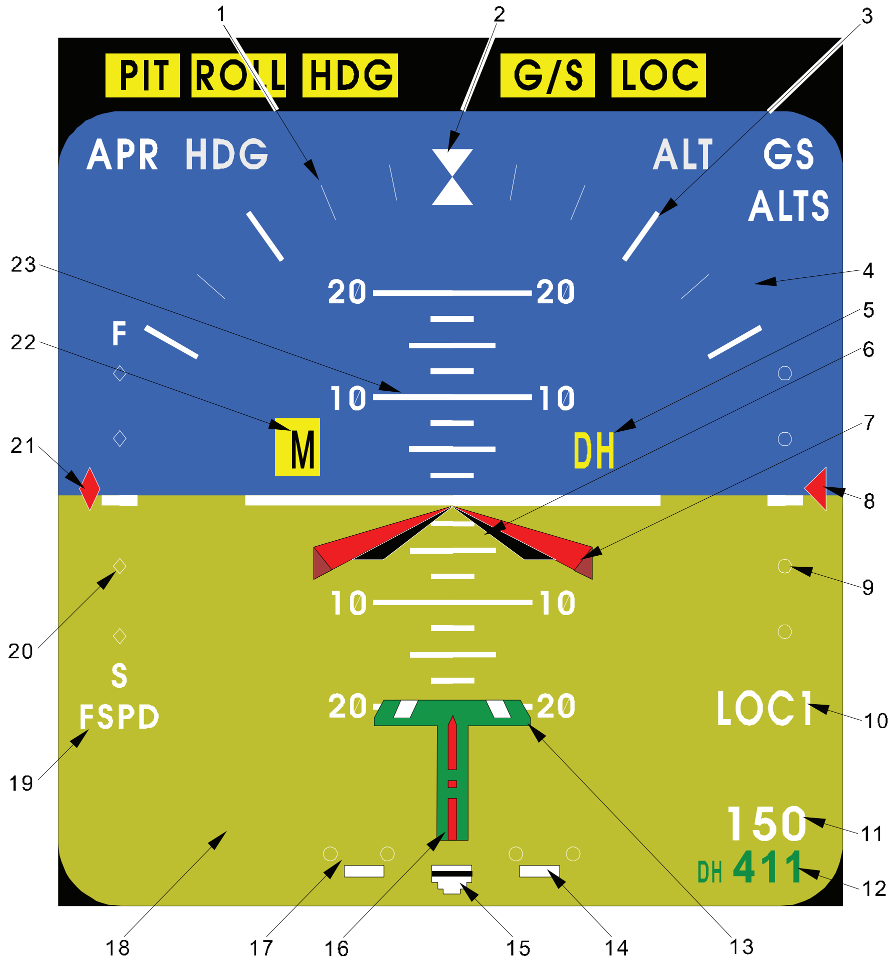
(1) Pitch and roll attitudes are indicated by the position of the blue sky and brown ground relationship. The aircraft symbol is outlined in white with a black interior. Precise pitch attitude is provided by the position of the pitch scale with reference to the nose of the aircraft symbol. Precise roll attitude is provided by the position of the moving roll pointer with reference to the roll scale. The pitch scale disappears behind the roll pointer and the lateral deviation pointer to prevent interference between the symbols. Roll is a continuous 360° display and pitch is ± 90° display.

If an attitude sensor failure occurs, an attitude flag appears which consists of a red box with black letters ATT. An attitude flag removes the pitch scale, roll scale, roll pointer, sky/ground raster, flight director annunciations and command bars from the display.

(2) The pitch scale, Figure 3B-5, consists of 2.5° increments between 30° to 40° of pitch. Approximately 40° of the pitch scale is visible at any given time.

(3) The roll scale displays the current roll attitude of the aircraft. It rotates about the aircraft symbol such that the aircraft roll is graphically indicated on the bank scale. The bank scale contains the ± 10°, 20°, 30°, 45°, and 60° increments. The rest of the scale is white. If the roll input is invalid or unavailable, the bank scale and pointer are removed from the screen and the ATT flag appears.

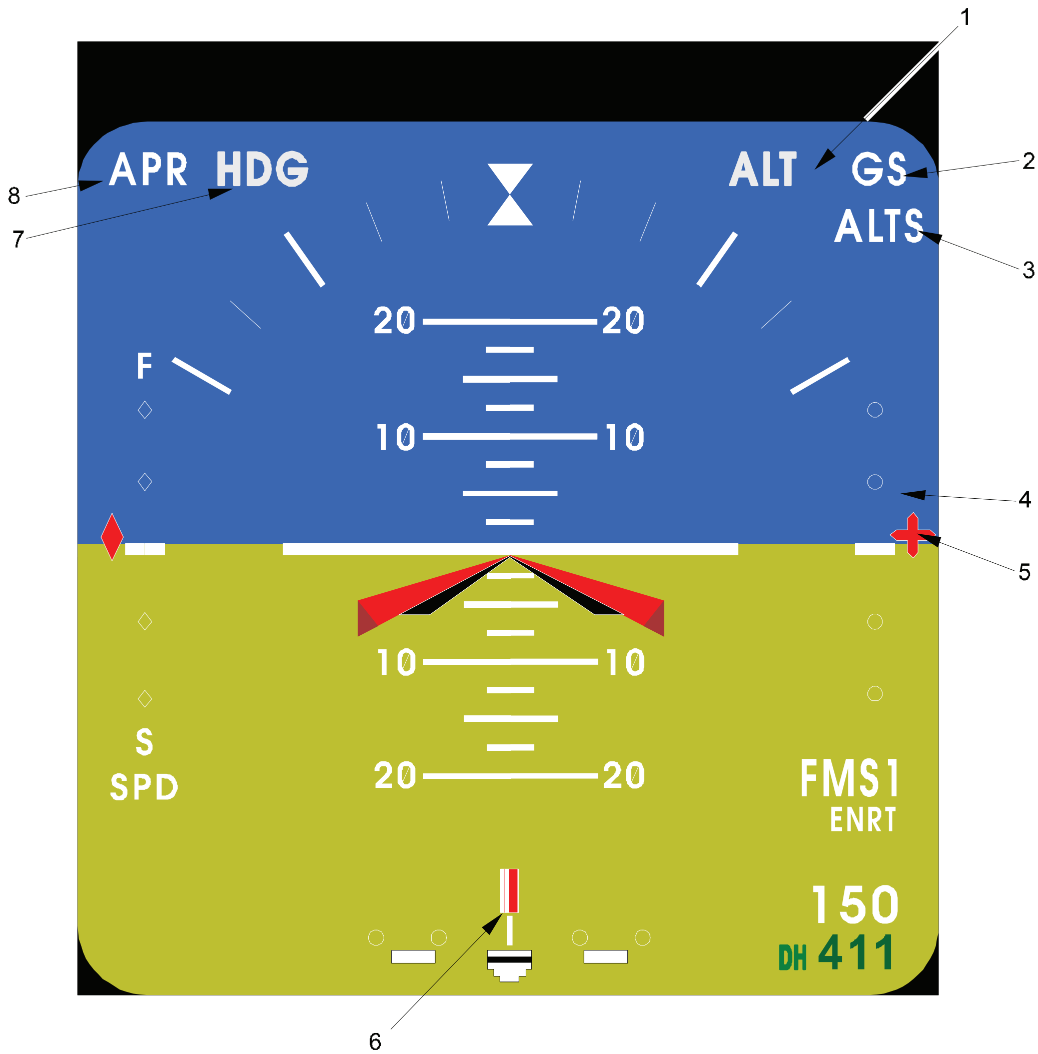
(4) If the pitch attitudes exceed + 30° or - 20° or if the bank attitude exceeds ± 65° all information except the aircraft symbol, attitude, and attitude sensor annunciation are removed from the ADI, refer to Figure 3B-5. All ADI information is restored when at + 25° or -15° of pitch or ± 60° of roll. If the PFD is displayed when an extreme attitude condition occurs, the excessive attitude ADI page automatically is displayed. Refer to Figure 3B-6. The PFD is not selectable until the extreme attitude condition is removed and then it must be reselected.



1. Roll Scale
2. Index Marks
3. 30° Bench Marks
4. Sky
5. Decision Height Annunciator
6. Aircraft symbol
7. Flight Director Command Bars (VBARS)
8. GS Pointer
9. Vertical Deviation Scale
10. NAV Source
11. Radio Altitude Readout
12. DH Setting
13. Rising Runway
14. Rate of Turn Scale
15. Rate of Turn Pointer
16. Lateral Deviation Approach Pointer
17. Lateral Deviation Scale
18. Ground
19. FMS Speed Label
20. Speed Deviation Scale
21. Speed Deviation Pointer
22. Marker Beacon Annunciation
23. Pitch Scale

Comparator Warning Annunciations at top of display in yellow

Figure 3B-4. ADI Display Symbology (Sheet 1 of 2)



1. Vertical Capture (ALT Hold, green)
2. Vertical Arm #1 (GS Armed)
3. Vertical Arm #2 (ALTSEL Armed)
4. Vertical Deviation Scale
5. VNAV Pointer
6. Lateral Deviation Non-Approach Pointer
7. Lateral Capture (HDG Mode Captured)
8. Lateral Arm (VOR APR Armed or LOC Source)

NOTE

ALT, APR or HDG, and GS green when captured.

Figure 3B-4. ADI Display Symbology (Sheet 2 of 2)

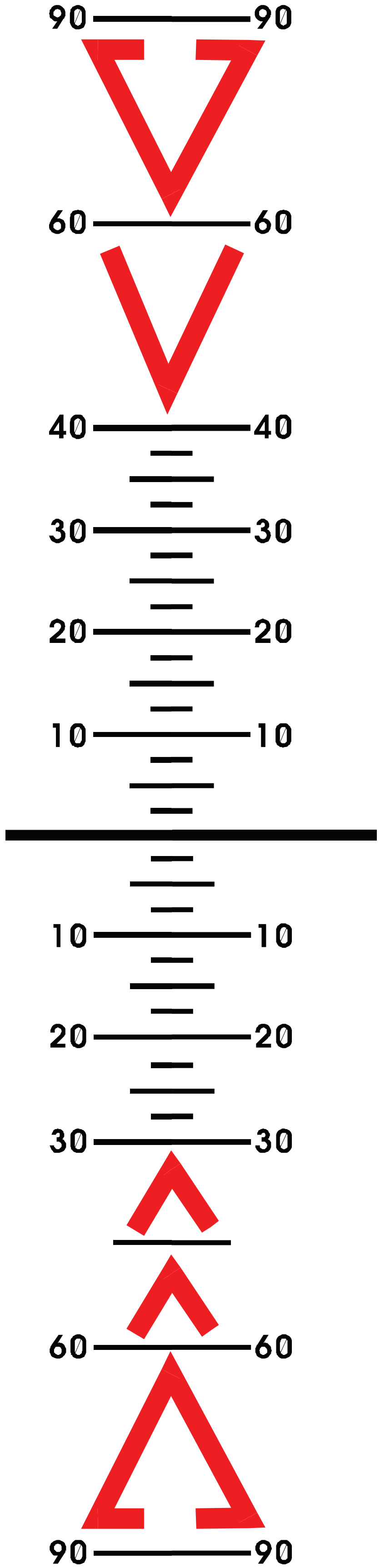


Figure 3B-5. ADI Pitch Scale

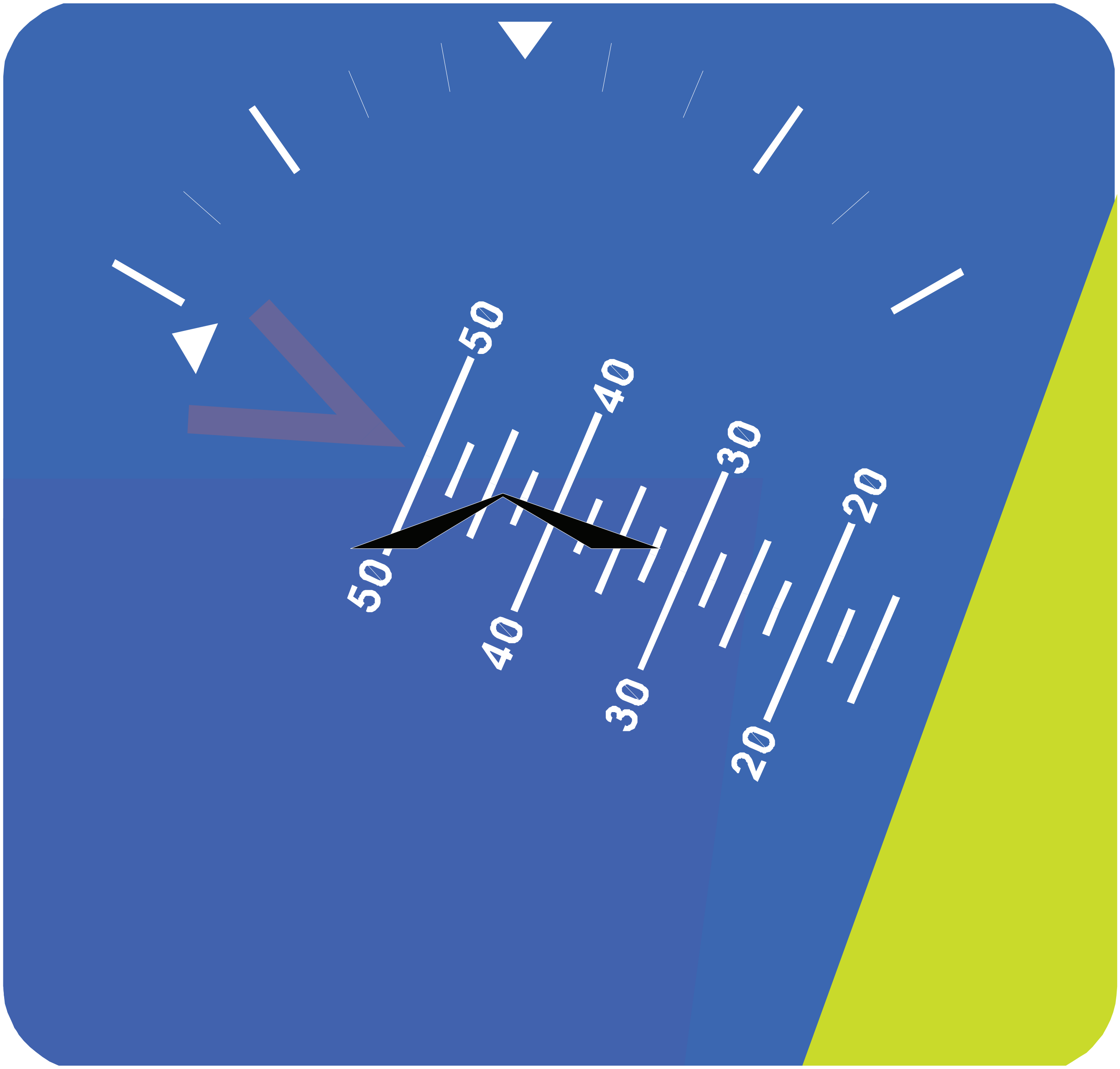


Figure 3B-6. ADI Excessive Attitude Display

(5) Flight Director Command Bar Display. The command bars are in view when a flight director mode has been selected. The command bars are removed from view when it is turned off, in standby mode, commanded out of view, and FD Validity Failed.

The integrated command bars flank the triangular aircraft symbol with a zero command input. The command bars move a maximum of ± 15° pitch and ± 30° roll.

The command bars are removed from the display and the flight director annunciation appears when the commanded pitch or roll is invalid. The flight director annunciation consists of the label FD in black on a solid red box.

c. Flight Director Annunciations. The Flight Director (FD) annunciations are displayed in the Lateral Arm, Lateral Capture, Vertical Capture, Vertical Arm 1, and Vertical Arm 2 annunciator fields. The capture annunciations are green and the arm annunciations are white. To ensure that the flight crew does not miss a FD change, the FD annunciation flashes for 5 seconds when a new annunciation occurs. Refer to Table 3B-1 for FD output and their annunciations.

The MFD displays red-colored dashes in the FD fields and retains the FD command bars if the FD sets more than one annunciation for that field or if the Data Concentrator Unit fails. The annunciator fields will be blanked when the command bars are removed from the display, when the unit is turned off, placed in standby mode, commanded out of view, or FD validity flagged.

d. Vertical Guidance. The FDS-255 supports glideslope and VNAV Guidance. The glideslope scale and pointer are displayed when the navigation source is LOC, the localizer is valid, and the glideslope is valid. The VNAV scale and pointer will be displayed when the navigation course source is FMS, the FMS is valid, the VNAV is valid, and the VNAV is available from the FMS.

A scale and pointer located on the right side of the indicator displays deviation from the selected vertical path. The scale consists of a pair of white dots above and below a white center index. Maximum travel of the pointer is 2.5 dots.

The glideslope (GS) deviation pointer is a magenta trapezoid outlined in white. If a glideslope failure is detected, the letters GS appear boxed and in red. The GS pointer and scale will be removed from the display. The GS pointer moves a maximum of ± 2.5 dots.

The VNAV deviation pointer is a magenta start outlined in white. When a VNAV failure is detected the VNAV annunciation appears boxed and in red. The VNAV pointer and scale will be removed. The pointer moves a maximum of ± 2.5 dots.

Table 3B-1. Flight Director Annunciations

ANNUNCIATOR FIELD	FD ANNUNCIATOR INPUT	MFD ANNUNCIATION
Lateral Arm (Upper Left-White)	NAV Arm (while LOC is NOT the NAV source)	NAV
	NAV Arm (while LOC is the NAV source)	APR
Lateral Arm (Upper Left-White)	BC Arm VOR APR Arm	APR
Lateral Capture (Upper Left-Green)	BC Capture VOR APR Capture	APR
	NAV Capture (while LOC is NOT the NAV source)	NAV
	NAV Capture (while LOC is the NAV source)	APR
Lateral Capture (Upper Left-Green)	HDG	HDG
	GA	GA
	LNAV	NAV
Vertical Arm 1 (Upper Right-White)	APPR Arm	GS
Vertical Arm 2 (Upper Right-White)	ALTS Arm	ALTS
Vertical Capture (Upper Right-Green)	APPR CAPT ALT Hold	GS ALT
	ALTS Capture	ALTS
	IAS	IAS
	VS	VS
	GA	GA

e. Lateral Deviation. The pointer and scale are located on the bottom center of the ADI. The pointer moves a maximum of ± 2.5 dots. The scale consists of two white dots on either side of a white center index.

The lateral deviation pointer is a white rectangle with two magenta bars for VOR, or non-approach FMS navigation sources. The rising runway serves as the lateral deviation pointer for LOC, BC, and approach FMS course sources. Back course deviation is reversed on the ADI when the B/C is set via the flight director control panel.

If the navigation source is invalid or missing, the course source annunciation is boxed in red and the pointer, rising runway (LOC, BC, or FMS approach), and lateral deviation scale are removed from the display.

The FMS Navigation warning indicates that the information accuracy is in question but usable. The FMS navigation solution remains displayed but the color changes to yellow.

f. Rate of Turn Indicator. The indicator displays turn rate information. It is located below the lateral deviation scale and consists of a three bar scale with an indicator shown as a white bar outlined in black. The pointer will deflect either left or right indicating the turn rate in that direction. The pointer moves a maximum of ± 2 bars, twice the standard rate turn. Refer to Table 3B-2.

Heading data is used to calculate the rate of turn. If this source is flagged, the rate of turn goes invalid. The pointer and scale are removed when the rate of turn is invalid.

Table 3B-2. Rate of Turn Scale

DOT DEVIATION	DEGREES PER SECOND	UNITS
2 Needle Widths (1 bar)	3°/Sec	Standard Rate Turn
4 Pointer Widths	6°/Sec	Twice Standard Rate Turn

g. Rising Runway. The rising runway is shown in green, white, and magenta, outlined in black when the course source is a localizer, back course, or FMS approach mode. During localizer or FMS approach deviation, the pointer is a trapezoidal runway symbol. When the radio altitude reaches 200 feet while in LOC, BC, or FMS approach mode, the runway symbol starts to rise. The symbol achieves maximum height when the radio altitude is at a value of zero feet. The rising runway correlates to approximately the bottom of the aircraft symbol. If the Localizer or FMS deviation is invalid or unavailable the rising runway will be removed. If the radio altitude fails the rising runway does not rise.

h. Radio Altitude Display. Radio altitude is displayed in white above the decision height readout area. The display appears automatically when within the radio altitude range (2500 feet) and changes to 50-foot increments between 2500 and 1000 feet, 10-foot increments between 999 and 100 feet, and 5-foot increments below 99 feet.

NOTE

Loss of radio altitude data will cause loss of the TCAS II due to the absence of required input data.

Radio altitude data is rate-limited to prevent nuisance radio altimeter changes as the result of fast changing data (uneven terrain). The digital readout will blank for valid radio altitude data less than 0 feet or over 2500 feet.

When a failure is detected, the radio altitude display is dashed red and the black letters RA in a solid red box is annunciated. DH set and the DH annunciator are also removed.

i. Decision Height Set Readout. Decision height set is displayed in the lower right corner and is green. If the radio altimeter system fails, the decision height readout is removed.

When the radio altitude is at or below the DH setting, the yellow letters DH appear in the right center portion of the ADI or PFD display. The DH annunciation flashes for 10 seconds after it appears. Once the DH annunciation appears, it will be removed when the radio altitude climbs at least 25 feet above the decision height setting or if the radio altitude is less than 10 feet. If the radio altimeter system fails, the decision height annunciator is removed and the radio altitude flag appears.

j. Fast/Slow Deviation and Pointer. Speed deviation indicates whether the aircraft is fast or slow relative to an established reference. The speed deviation scale consists of four white dots with the letters F and S to the left of the top and bottom dots. The scale is located on the left side of the ADI. The speed deviation pointer is a magenta diamond outlined in white. The scale is relative to FMS speed (FSPD) associated with FMS 1. Whenever FMS speed is available the letters FSPD in white is positioned below the scale. When selected, Fast/Slow input is invalid and the source is drawn in black on a solid red box. The Speed Deviation Pointer is displayed in yellow when the cross-side FMS is the selected navigational source. The pointer and scale will be removed from the display.

k. Inclinometer Indicator. The inclinometer is a separate element mounted under each display. The inclinometer is a weighted ball in a liquid filled curved glass tube to provide assistance in making coordinated maneuvers. Aircraft slip/skid movement is shown by the movement of the ball.

l. Marker Beacons. The inner, middle, or outer marker beacon annunciation is displayed on the center left of the display when set by the marker beacon receiver. The marker beacon annunciator will be removed from the display when the marker beacon signal is no longer available from the marker beacon receiver. The marker beacon annunciator consist of an **O** in yellow for the outer marker, **M** in cyan for the middle marker, and **I** in white for the inner marker.

m. Free Format Line. The free format line displays system faults and selected ARC 210 frequencies and callsigns .

n. Comparator Warning Annunciation. Each display compares pitch attitude, heading, glideslope deviation, localizer deviation, and radio altitude to the cross-side (X-side) display. If the comparison exceeds a threshold, the appropriate annunciation appears at the top of the EADI.

o. Primary Flight Display (PFD) Format. The PFD is a reversionary mode and consists of an ADI positioned on top of an HSI with a portion of a 360° compass rose. Refer to Figure 3B-7.

(1) The rising runway and lateral deviation pointer is removed from the ADI.

(2) Approximately 30° of the pitch scale is visible.

(3) The Lubber Line is a solid white triangle pointer and heading is not digitally displayed.

(4) Approximately 200° of the compass rose is displayed. The bottom half of the compass rose is clipped from view.

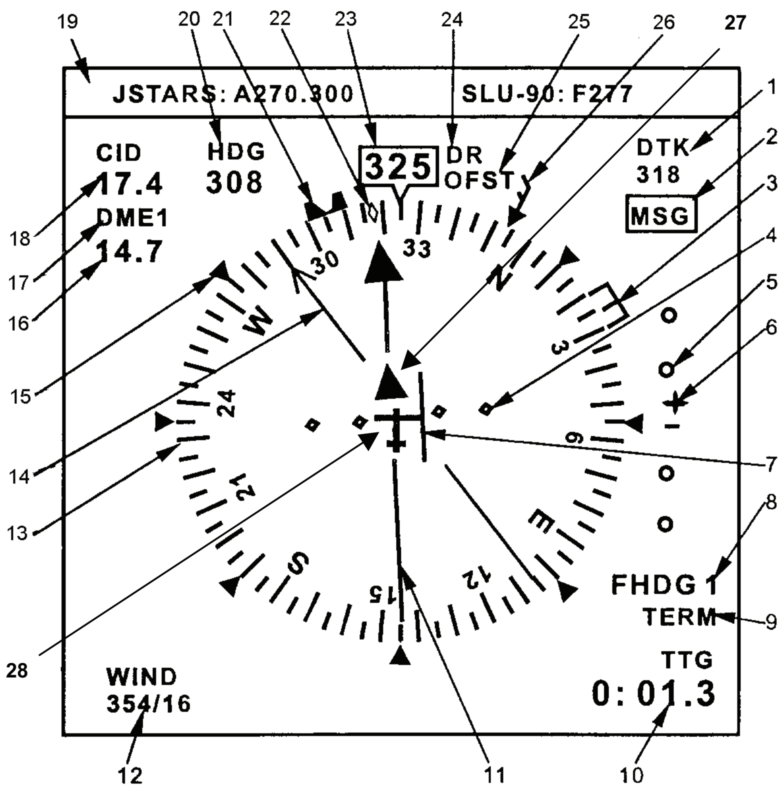
Figure 3B-7. Primary Flight Display Mode Display

In extreme pitch attitudes, the presentation reverts to the normal excessive attitude display that is a modified full ADI display.

3B-16. ELECTRONIC HORIZONTAL SITUATION INDICATOR.

a. Description. The Electronic Horizontal Situation Indicator (EHSI) is located on the instrument panel directly below each pilot and copilot's EADI. It is physically identical to the EADI, except it is configured as an EHSI. Flight data information is electronically displayed on both EHSI's. Refer to Figure 3B-8.

b. Power. Twenty-eight Vdc power is provided to each EHSI through separate 7–1/2 ampere circuit breakers labeled **EHSI** and located on the right side circuit breaker panel under the **NO. 1** and **NO. 2 FLT DSPL SYS**.



1. Course Readout / Label
2. FMS Message Alert
3. FMS Heading Bug
4. Course Deviation Scale
5. Vertical Deviation Scale
6. Vertical Deviation Pointer
7. Lateral Deviation Bar
8. Nav Source
9. FMS Flight Modes
10. Selectable Nav Data
11. Course Pointer
12. Wind Direction Degrees, Velocity, Knots
13. Compass Rose
14. Bearing Pointer
15. Compass Benchmarks
16. Distance of Bearing Source
17. Bearing Source
18. Distance to Nav Source
19. Free Format Line (ARC-210 Freq)
20. Digital HDG Bug Readout
21. Heading Bug
22. Track Indicator
23. Digital Heading Readout
24. DR or RAIM Alert
25. FMS OFST
26. Wind Pointer
27. TO / FROM Indicator
28. Miniature Aircraft

Figure 3B-8. Electronic Horizontal Situation Indicator

c. EHSI Modes. The EHSI allows for multiple display formats. See Table 3B-3 for the display formats that are selectable from the control panel.

Table 3B-3. EHSI Display Modes

MODE	FORMAT
HSI	HSI (360° compass) HSI ARC (Partial 80° compass)
MAP	Map ARC (Partial 80° compass) Map (360° reference)
Diagnostics	MFD Status

d. EHSI Outputs. The EHSI outputs the following to the flight director:

(1) HDG Datum.

(2) CRS Datum.

(3) LOC if the nav source is LOC.

(4) Lateral Deviation.

(5) Glideslope Deviation is sent to the flight director when it is available.

(6) Roll Steering. The bottom MFD outputs roll steering to the flight director when the flight director is valid and the course source is FMS.

e. HSI Graphic Format. The following graphics are utilized on the EHSI during the HSI Mode.

(1) Course Readout/Label. When a valid source is tuned, the course selected is displayed in white. Next to the course readout is the label CRS or DTK in white letters. The digital CRS or DTK readout is always associated with the course source.

(a) Radial Source (VOR). The course label is CRS and the digital course readout is independently controlled by each MFD control panel.

(b) FMS-800 Operation. The label is CRS when the primary source is not FMS. If the primary source is tuned to FMS, the CRS will be replaced with Desired Track (DTK) for all FMS modes except TO / FROM mode (TACAN Emulation). When FMS is the course source the course is automatically set by FMS.

(c) KLN 90B Operation. Refer to **OBS / LEG** switch in Paragraph 3D-20 for a description of the course readout.

(2) Message Alert. The message (MSG) alert appears whenever the FMS sends an alert to the MFD. The yellow MSG alert indicates to the crew that they should look at FMS on the selected side of the cockpit [on-side/x (cross) side].

(3) FMS-800 Heading Bug. The FMS heading bug is only available for display when the FMS-800 is the NAV source and the FMS is commanding the bug to be displayed. The FMS heading bug is white and travels about the aircraft symbol around the outer edge of the compass. The center of the FMS heading bug indicates the selected heading in 1° increments. When the FMS selected heading is set, the FMS NAV source label is replaced with FHDG 1 in white letters. If the FMS selected heading is invalid, unavailable, or the primary course source is not FMS 1, the heading bug will not be displayed. The FMS selected heading bug is displayed in yellow when a cross-side source is selected.

(4) Course Deviation Scale. Four white lateral deviation scale dots indicate deviation from course. The course deviation scale rotates about the aircraft symbol such that the scale is always perpendicular to the selected primary course. The maximum deviation is ± 2.5 dots. When the selected course or source is invalid, the course deviation scale is removed from the display.

The EHSI outputs lateral deviation and lateral deviation validity to the flight director and/or autopilot. The lateral deviation validity signal corresponds with the selected course source's lateral deviation. The lateral deviation output flag is displayed when the lateral deviation for the selected primary navigation source is invalid or an MFD failure results in bad or failed lateral deviation output.

(5) Vertical Deviation Scale. The Vertical Deviation Scale, four small circles located on the right side of the MFD indicate the vertical deviation of the aircraft.

(6) Vertical Deviation Pointer. The Vertical Deviation Pointer, represented by a white star, displays the deviation with respect to the selected source.

(7) Lateral Deviation Bar. The center of the course pointer moves laterally with respect to the aircraft symbol and the four white deviation scale dots to indicate lateral deviation. The course deviation scale rotates about the aircraft symbol so that the scale is always perpendicular to the selected primary course.

(8) Nav Source Annunciations. The navigation sensor is annunciated in white at the right center of the display. The possible nav source annunciations are as follows:

1. FMS 1 or FHDG 1
2. FMS 2
3. VOR 1, LOC 1, or BC 1
4. VOR 2, LOC 2, or BC 2

The NAV source label is displayed in yellow when a cross-side source is selected. When both the on-side and cross-side displays have the same NAV source selected, the NAV source label is boxed in yellow.

If a NAV sensor failure is detected while selected as the nav source, the sensor annunciator becomes red and boxed.

If FMS 1 is selected and a FMS NAV Warn occurs, the FMS 1 nav source annunciator turns yellow.

If FMS 1 is selected as the primary source, the FMS mode is annunciated in white below the primary navigation source. The FMS 1 modes are NONE, APPR, ENRT, OCNC, or TERM. The FMS mode will flash for 10 seconds starting 1 mile prior to transitioning into APPR mode. When the mode is NONE or ENRT the annunciation field will be blank.

If the FMS 2 course is selected as the primary source then the FMS mode is annunciated in white below the course source. The FMS 2 course modes are ENRT, APPR, or TERM. The FMS mode will flash for 10 seconds during the transition from TERM to APPR. When the mode is ENRT the annunciation field will be blank.

(9) FMS Flight Modes. If FMS 1 is selected as the primary source, the FMS mode is annunciated in white below the primary navigation source. The FMS 1 modes are NONE, APPR, ENRT, OCNC, or TERM. The FMS mode will flash for 10 seconds starting 1 mile prior to transitioning into APPR mode. When the mode is NONE or ENRT the annunciation field will be blank.

If the FMS 2 course is selected as the primary source, the FMS mode is annunciated in white below the course source. The FMS 2 course modes are ENRT, APPR, or TERM. The FMS mode will flash for 10 seconds during the transition from TERM to APPR. When the mode is ENRT the annunciation field will be blank.

(10) Data Selection Display (Navigation Data). The **DATA** selection knob on the FDS 255 control panel provides sequential selection of the following data from the on-side FMS: OFF, GS, TAS, TTG, ET, or OFF (no navigation data displayed). The selected data is displayed in white in the lower right hand corner of the display. When the data is invalid, the digital value is replaced with red dashes. If the data is unavailable, the data value is blanked.

(a) FMS-800 Operation. OFF, GS, TAS, TTG, and ET are valid data displays for the FMS-800.

(b) KLN 90B Operation. OFF, GS, and TTG are valid data displays for the KLN 90B.

(11) Course Pointer. The selected course is shown by the relationship of the solid single bar arrow (pointer) with respect to the compass card and is repeated numerically in the upper right corner. The course pointer is white for all navigation sources. The digital course readout and course needle change by 1° increments and rotate such that the needle head points to the selected primary course on the compass.

(12) Wind Direction. The MFD displays wind velocity (knots) and direction (degrees) on the bottom of the MFD in green below the label **WIND.** If no wind data is available, the data will be blank. If the wind data is invalid, the data will be dashed red.

(13) Compass Rose (360°). The compass rose provides a graphical representation of the current heading of the aircraft. It is a full 360° rose approximately 3 inches in diameter with **N**, **E**, **S**, and **W**, designating the cardinal points and numerics at the 30° points. Aircraft heading is read against the lubber line. Major division marks are every 10° and minor division marks are every 5° on the compass rose. The compass card, lubber line, and reference lines are white.

(14) Bearing Pointer. The bearing source is selected by the bearing switch on the control panel. The bearing arrow is a solid cyan line with an open arrow extending through the aircraft symbol to the minor tick marks on each side of the compass. The arrowhead points to the compass location corresponding to the bearing of the station.

(15) Benchmark. A compass benchmark surrounds the compass rose. The benchmarks are white triangle marks located every 45° except at 360° along the outside of the compass rose.

(16) Distance of Bearing Source. When distance is available for the selected bearing source the distance source and the distance in nautical miles to the NAV source is displayed in the upper left corner of the MFD. When the bearing source is FMS the active waypoint is displayed as the distance source. If the bearing source is VOR, DME will be displayed as the distance source.

NOTE

If an offside FMS is selected for Bearing Data/Distance and it is not activated as the primary NAV source on the off-side, the distance/bearing information will not be displayed. This is caused by the method of data importation into the EHSI displays. If the offside FMS data is required, the offside primary NAV source must be selected.

The distance readout displays tenths of a mile up to 99.9 nm, and above 99.9 nm it displays whole miles. If VOR is the selected course source and the VOR is in DME hold mode, a cyan H is annunciated to the right of the DME distance.

When the distance is invalid, the digital portion of the readout is replaced with red dashes. If the distance is unavailable the digital portion of the readout blanks. When the bearing source is invalid or not available, the distance source is replaced with the bearing source annunciation drawn in black on a solid red box.

(17) Bearing Source. The bearing source is identified in cyan in the upper left corner of the EHSI below the Course Source/Distance. When the bearing is unavailable, the needle is removed but the source annunciation remains. When the bearing source is invalid, the needle is removed from the display and the bearing source annunciation is replaced with the source abbreviation drawn in black on a solid red box.

(18) Nav Source Distance Readout. When distance is available for the selected nav source the distance source and the distance in nautical miles to the NAV source is displayed in the upper left corner of the MFD. If the nav source is FMS the active waypoint is displayed as the distance source. If the nav source is VOR, DME is displayed as the distance source.

The distance readout displays tenths of a mile up to 99.9 nm, and above 99.9 nm it displays whole miles. If VOR is the selected nav source and the VOR is in DME hold mode, a white H is annunciated to the right of the DME distance.

When the distance is invalid the digital portion of the readout is replaced with red dashes and the distance source is replaced with the nav source annunciation. If the distance is unavailable the distance identifier is replaced with the nav source annunciation and digital portion of the readout blanks.

(19) Free Format Line. The free format line is a 32-character message line filled by the FMS-800. The FMS-800 controls the content of the message, color, and flashing of characters. The message line displays the active and last tuned ARC-210 frequencies. The left side of the message line consists of the active communication call sign and frequency in green. The right side of the message line consists of the last-tuned communication call sign and frequency in cyan.

(20) Digital Heading Bug Readout. Located to the right of the Course Source/Distance. When the selected heading changes the selected heading readout is displayed. If the selected heading does not change for 10 seconds, the selected heading readout is removed from the display. If the heading bug is off the screen, the readout will be constantly displayed.

(21) Heading Bug. The heading bug is magenta and travels around the aircraft symbol on the outside edge of the compass. It travels in 1° increments. The center of the heading bug indicates the selected heading in 1° increments. When the heading bug or heading source is invalid, the heading bug is not displayed.

(22) Track Indicator. The track indicator shows the actual course of the aircraft. It is drawn as a cyan diamond. It travels around the aircraft symbol on the inner edge of the compass rose, such that the bottom of the indicator points into the compass and is aligned with the track value on the compass. The track indicator is removed from the display if it becomes invalid or unavailable. The track indicator is displayed in yellow when a cross-side source is selected.

(23) Digital Aircraft Heading Readout. The compass rose rotates about the aircraft symbol such that the current heading is graphically indicated below the lubber line. Within the white lubber line symbol is a white digital heading readout. The lubber line is located directly above the aircraft symbol along the outside of the compass rose.

When the heading is invalid, the bearing pointer and the HSI go into OBS backup modes.

When the heading is invalid, the heading readout is removed from the display and replaced with the heading annunciator. The heading is labeled HDG in black letters on a solid red box.

(24) Dead Reckoning and Receiver Autonomous Integrity Monitoring Alert. The display annunciates Dead Reckoning (DR) or Receiver Autonomous Integrity Monitoring (RAIM) in yellow to the right of the digital heading readout. If DR and RAIM Alert are present at the same time, DR overrides the RAIM Alert.

The FMS goes into DR when it loses navigation sources. When FMS goes into DR, it calculates its present position based on inertial data. The display annunciates DR in yellow to the right of the digital display.

(25) Offset. The crew can select a parallel offset (OFST) source via the FMS. The lateral deviation scale is relative to the parallel offset course. **OFST** is annunciated to the right of the digital heading readout in white.

(26) Wind Pointer. The wind indicator consists of a green symbol located on the outside edge of the compass and graphically layered to not obscure the heading bug symbol, lubber line, or heading readout. The wind indicator rotates about the aircraft symbol such that the arrow is always pointing into the compass at the wind direction. The arrow displays zero to five green fins on its tail to represent wind speed. Long fins represent 10 knots and short fins represent 5 knots. If the wind velocity is 0 knots, the arrow is removed from the display. If the wind velocity is less than 2.5 knots the arrow is displayed with no fins. The wind indicator indicates wind from .1 knots to 45.5 knots. If the wind exceeds 45.5 knots, the wind indicator changes to a maximum wind symbol (wind indicator with a filled triangle fin at the tail). When the wind speed or wind direction is invalid or unavailable, the wind indicator is removed from the display.

(27) To/From Indicator. A white triangle to or from indicator rotates around the aircraft symbol on the course needle. It indicates TO the station when the triangle points towards the head of the course needle and FROM the station when the triangle points towards the tail of the course needle. If FMS is the selected course and FMS outputs a waypoint alert, the TO **/** FROM flag flashes.

If the nav source is not FMS, the indicator is set to TO when the angular difference between the relative bearing to the station and the primary course is less than 89°. When the angle is greater than 91° FROM is indicated. The indicator is OFF when the angle is between 89° and 91°. When FMS is the primary source then the FMS determines the TO **/** FROM indication. If the TO **/** FROM indication is invalid or unavailable, an active navaid has not been selected, or the indicator is OFF, the TO **/** FROM flag will be removed from the display.

(28) Aircraft Symbol. The white aircraft symbol is located in the center of the compass rose.

f. EHSI Operations.

(1) OBS Backup Mode. When the heading is invalid the compass rose rotates about the aircraft such that the selected course is always referenced at the top of the display. When the selected course is invalid the compass freezes at the last known position.

(2) Nav Source Flag. When the navigation information for the selected course is flagged invalid, the nav source label is removed from the display and replaced with the nav source annunciation drawn in black on a solid red box. The deviation bars and scale are removed from the display with a navigation flag. If the primary course goes invalid, the selected course readout is replaced with red dashes. If FMS-800 or the KLN 90 is selected and an FMS NAV Warn occurs (RAIM Alert), the **FMS NAV** source annunciator turns yellow and all the navigation information remains on the display.

(3) LOC/BC. If an LOC frequency has been tuned and backcourse is selected on the flight director, BC is displayed in place of the LOC source. Once BC has been set it will remain set as long as the BC discrete is set.

g. HSI ARC Format. The compass arc format, Figure 3B-9, is a graphical representation of the current heading of the aircraft. It is similar to the compass rose except only an 80° section is shown. The arc format is an expanded compass with the compass segment at the top of the display and the aircraft symbol centered laterally at the bottom. The compass rotates about the center point of the aircraft such that the current heading is indicated directly below the lubber line.

The HSI format with the 360° compass rose display is the same as the HSI Arc display with the following exceptions:

(1) Selected HDG Readout. A digital readout of selected heading is displayed in the upper left-hand corner of the display. When the heading bug is visible, it will appear when the selected heading is changed and is removed 10 seconds after the heading bug quits moving. If the heading bug is off the screen, the readout is constantly displayed.

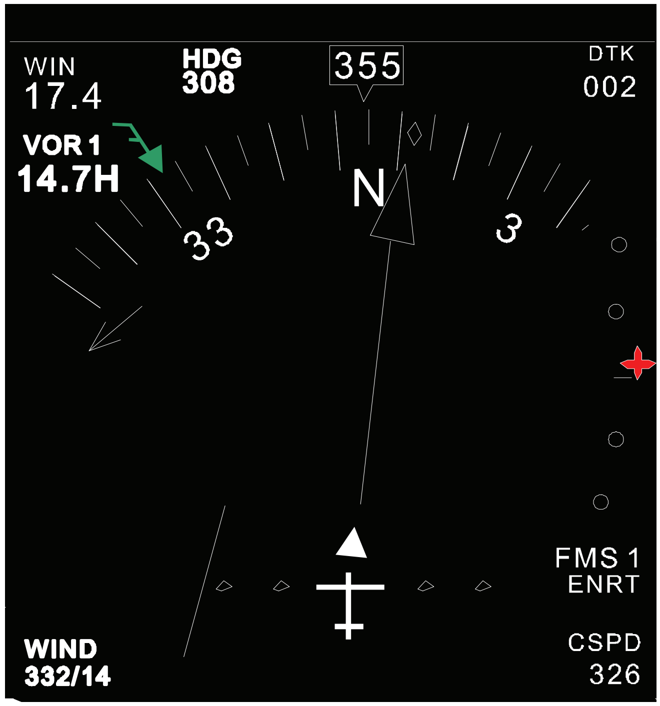


Figure 3B-9. HSI ARC Format (Off Display CRS, HDG, and Bearing)

(2) Course Needle. When the primary course moves out of view, the primary course needle and deviation bar size reduces so that the head or tail is always visible.

(3) Bearing Needle. When the bearing needle head and tail are outside of the displayable area, a cyan bearing needle appears on the inside of the compass within its major tick marks pointing to where the needle head would be.

h. Map ARC Format (Partial 80°). The Map ARC format (Heading Up Map, Figure 3B-10) is an expanded rose format with a compass segment at the top of the display and the aircraft symbol centered laterally at the bottom. The ARC Map provides a display of the active flight plan. Refer to Figure 3B-11 for a description of the map symbols.

The operation of the peripheral information, compass rose and annunciations, are the same as the HSI ARC mode with the following exceptions:

(1) Range Arc. The range knob, concentric with the mode switch, selects range on the map format. The static dashed range ring and label consist of one cyan arc and cyan text representing half the value of the range setting. The arc is half way between the aircraft symbol position and the point of the lubber line. Available full-scale ranges are 2.5, 5, 10, 20, 40, 80, 160, 320, and 640 NM.

(2) Selected HDG Readout. A digital readout of selected heading is displayed in the upper left-hand corner of the display. When the heading bug is visible, it will appear when the selected heading is changed and is removed 10 seconds after the heading bug quits moving.

(3) FMS Waypoints Displayed. The MFD will display up to 15 FMS waypoints of a flight plan. One past and fourteen future waypoints are located in their proper rho-theta position with respect to the selected range and aircraft symbol. The active waypoint is magenta and all other waypoints are drawn in white. Waypoints are identified by identifiers next to the waypoint symbol. An Arc pattern or a holding pattern associated with the active waypoint (TO) is drawn if the pattern is activated. If not, an ICON symbol representing the pattern type is drawn. Pattern ICON's are drawn next to all future waypoints that have an associated pattern. DME Arcs are drawn whenever they are present.

If an FMS is attached to the MFD a waypoint alert occurs when the aircraft is about to reach the active waypoint. The active waypoint flashes to indicate a waypoint alert.

i. Active Flight Plan and Other Nav Sources. If FMS is the selected nav source, waypoint symbols are connected together by course lines of solid magenta ARC's, unless a gap in the course line connections, are commanded by the FMS. The active waypoint and course line are drawn in magenta. Other symbols and lines are drawn in white. If the rho-theta location of a waypoint lies off the displayable map area a course line is drawn to the edge of the display. All the waypoints that lie after that waypoint are not connected with course lines. If VOR is selected as the nav source, bearing lines are drawn on the map instead of course lines.

j. **Nav Source Failure**. When the selected nav source sensor failure is detected, the sensor annunciator becomes red and boxed and all symbols and course lines are removed from the display. If the nav source goes invalid, the selected course readout is replaced with red dashes. If a heading source fails, all NAV information is removed from the display.

Figure 3B-10. Map ARC Format

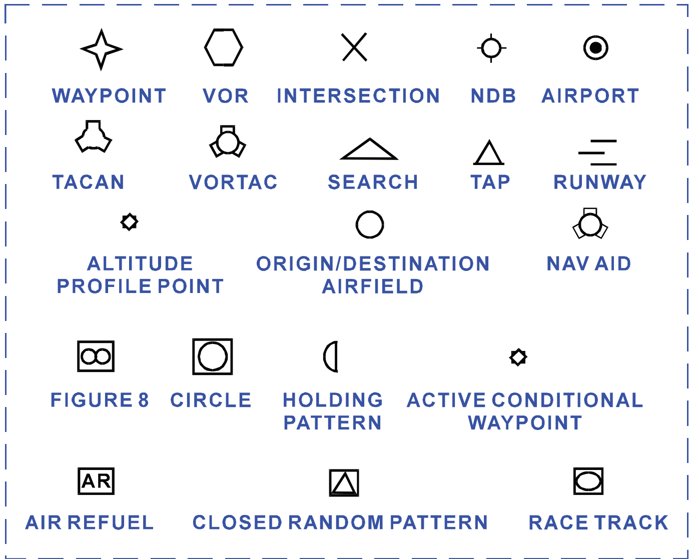


Figure 3B-11. Map Symbol

k. FMS-800 Map Display Operation. Refer to Table 3B-4 for display options.

(1) NAV Warning. If the accuracy of the FMS navigation falls below the 95% threshold, a NAV Warn occurs. All navigation information remains on the display during a NAV Warn. The NAV Warn is indicated by changing the FMS Primary NAV source annunciator to yellow.

Table 3B-4. FMS-800 Map Display Operation

MAP MODE	PREVIOUS WAYPOINT DISPLAYED	COURSE LINE TO ACTIVE WAYPOINT
FMS To-To	Yes	Previous and Active waypoint are connected. The FMS flies a DTK.
FMS Direct-To	No	Desired Track line is drawn to the active waypoint from the computer Direct-To position
FMS To-From	Yes	Manually entered course line is drawn to the Active waypoint.
Manual Sequencing	Yes	A dashed line extends from the active waypoint.

l. KLN 90B Map Display Options. Refer to Table 3B-5 for display options.

Table 3B-5. KLN 90B Map Display Options

MAP MODE	PREVIOUS WAYPOINT DISPLAYED	COURSE LINE TO ACTIVE WAYPOINT
Leg Mode	Yes	Previous and Active waypoint are connected. The FMS flies a DTK.
OBS Direct-To Mode	No	Desired Track line is drawn to the active waypoint from the aircraft's current position.
OBS Mode	Yes	Manually entered course line is drawn from the Active waypoint.
Manual Sequencing	Yes	A dashed line extends from the active waypoint.

m. VOR Map Display Operation. Refer to Table 3B-6 for the display option.

If the primary source is a VOR, a solid white bearing line is drawn from the aircraft to the VOR station. Since distance information is not available to the VOR station, the VOR station symbol is not drawn.

The bearing line will always extend to the edge of the map. When the bearing is invalid or unavailable, the bearing line is removed from the display and the primary source abbreviation displayed in black letters on a solid red box.

Table 3B-6. VOR/TCN Display Option

MAP MODE	PREVIOUS WAYPOINT DISPLAYED	BEARING LINE TO ACTIVE WAYPOINT
VOR	No	Bearing line extends from the aircraft symbol towards the station. The VOR symbol is not displayed.

n. Bearing Needle and Bearing Source. The bearing needle and bearing source display and operation is the same as on the HSI ARC display.

o. Map Format (Full 360 Degree Compass Map). The map display, Figure 3B-12, provides position awareness information to the crew. The operation of the peripheral labels and annunciations is the same as the ARC display mode. The map (full 360°) format is reached by toggling the **ARC** push button while in the Map mode. To return to the Map ARC mode (partial 80° compass) toggle the **ARC** push button.

p. Compass Display. The current heading is graphically indicated within the lubber line. A digital white current heading readout is provided within the white lubber line symbol. The point of the lubber line is located directly above the aircraft symbol along the outside of the selected range ring. Next to the heading readout is the heading reference indicator (**T** = True reference, Blanked reference = Magnetic reference).

When the heading is invalid, the heading readout is removed from the display and replaced with the heading annunciator. The heading annunciator displays HDG in black on a solid red box.

q. Range Ring. The range knob selects range on the MAP format. The range ring is displayed in cyan with the aircraft symbol located in the center of the ring. Two range rings are displayed, an outside range ring is labeled with the selected range and passes directly under the lubber line. The range ring is stationary and provides tick marks in 30° intervals. The inner range ring is half the selected range. It is a cyan dashed ring. Available full-scale ranges are 2.5, 5, 10, 20, 40, 80, 160, and 320 NM. A digital readout of the selected heading is displayed in the upper left-hand corner of the display. The bearing needle and bearing source display and operation is the same as on the 360° HSI.

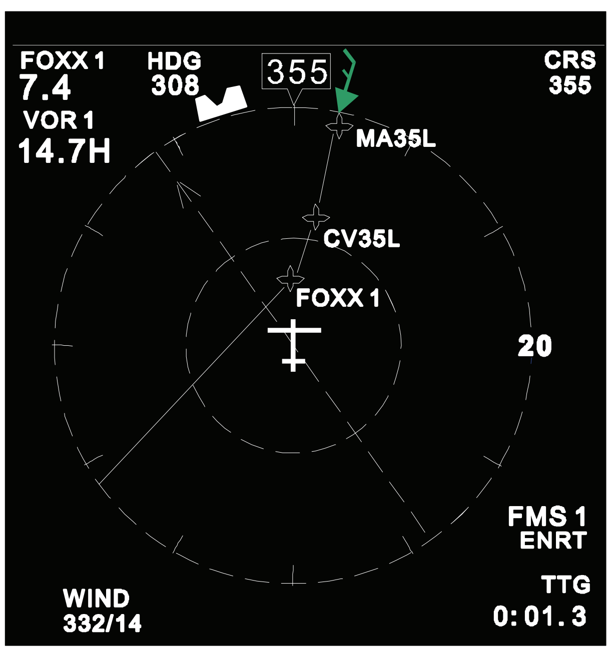


Figure 3B-12. 360 Degree Map

3B-17. AUTOMATIC FLIGHT CONTROL SYSTEM.

a. Description. The Automatic Flight Control System is a completely integrated autopilot/flight director/air data system that has a full complement of horizontal and vertical flight guidance modes. These include all radio guidance modes, and air data oriented vertical modes.

When engaged and coupled to the flight director commands, the system will control the aircraft using the same commands displayed on the electronic attitude director indicator. When engaged and uncoupled from the flight director commands, manual pitch and roll commands may be inserted using the Touch Control Steering (TCS) or the pitch wheel and turn knob.

When the autopilot is coupled, the flight director instruments act as a means to monitor the performance of the autopilot. When the autopilot is not engaged, the same modes of operation are available for flight director only. The pilot maneuvers the aircraft to satisfy the flight director commands, as does the autopilot when it is engaged.

NOTE

The autopilot will disengage when transferring between the pilot and copilot flight directors.

b. Autopilot Flight Director Transfer Panel. A panel, containing an alternate action autopilot and flight director transfer switch, placarded **AP FD 1** / **AP FD 2**, is located on the left (Pilot's) instrument panel. This switch is used to select which autopilot flight director computer controls the aircraft flight servos. If **AP FD 2** is selected, the annunciators, placarded **AP FLT DIR NO. 2**, located above the copilot's airspeed indicator, and the annunciator, placarded **AP FLT DIR NO. 1,** located above the pilot's altimeter, will illuminate to alert both pilots that the No. 2 autopilot flight director computer is controlling the aircraft. If the **AP FD 1** is selected, only the annunciator labeled **AP FD 1** above the pilot's altimeter will illuminate.

c. Air Data Computer. A digital air data computer located in the forward avionics compartment provides the altitude information for the pilots' servoed altimeter, altitude alerter, flight data recorder, and transponder. The computer also provides altitude and airspeed hold function data to the flight control computers, generates and provides true airspeed to the data field on the EHSI with inputs from the airspeed/temperature probe. The air data computer receives 28 Vdc power through, and is protected by, a 2-ampere circuit breaker, placarded **AIR DATA-ENCODER**, located in the Avionics section of the circuit breaker panel. All air data computer functions are automatic in nature and require no flight crew action.

d. Flight Director/Mode Selector. This provides all mode selection (except go-around that is initiated by a remote switch) for the flight director. The top row of light annunciated push buttons contains the lateral modes and the bottom row contains the vertical modes. The split-light push buttons illuminate yellow for armed conditions and green for captured. When more than one lateral or vertical mode is selected, the flight director system automatically arms and captures the submode.

(1) Heading Select Mode. The Heading Select Mode (HDG) is selected by pressing the **HDG** button on the mode selector. The HDG annunciator illuminates. In the HDG mode, the flight director computer provides inputs to the command cue to command a turn to the heading indicated by the heading bug on the HSI. The heading select signal is gain programmed as a function of airspeed. When HDG is selected, it overrides the NAV, BC APR and VOR APR modes. In the event of a loss of valid signal from the VG or compass, the command cue is biased out of view.

(a) Navigation Mode. The Navigation Mode (NAV) represents a family of modes for various navigation systems including VOR, or Localizer as selected by the EFIS control panel.

(b) VOR Mode. The VOR Mode is selected by pressing the **NAV** button on the mode selector with the navigation receiver tuned to a VOR frequency and DME greater than 20 miles from the station. Prior to VOR capture, the command cue receives a heading select command as described above and the HDG mode annunciator on the mode selector is illuminated along with the NAV ARM annunciator on the mode selector. Upon VOR capture, the system automatically switches to the VOR mode, HDG and NAV ARM annunciators extinguish, and **NAV CAP** annunciator on the mode selector will illuminate. At capture, a command is generated to capture and track the VOR beam. VOR deviation is gain programmed as a function of distance from the station. This programming corrects for beam convergence thus optimizing the gain through the useful VOR range. To utilize this feature the DME must be tuned to the same VOR station as the NAV receiver that is feeding the flight director. The course error signal is gain programmed as a function of airspeed. Crosswind washout is included which maintains the aircraft on beam center in the presence of crosswind. The intercept angle and DME distance are used in determining the capture point to ensure

smooth and comfortable performance during bracketing.

When passing over the station, an overstation sensor detects station passage removing the VOR deviation signal from the command until it is no longer erratic. While over the station, course changes may be made by selecting a new course on the EHSI.

If the NAV receiver is not valid prior to the capture point, the lateral beam sensor will not trip and the system will remain in the HDG mode. After capture, if the NAV receiver, compass data or vertical gyro go invalid, the command cue will bias out of view. The **NAV CAP** annunciator on the mode selector will extinguish if the NAV receiver becomes invalid.

(c) VOR Approach Mode. The VOR Approach Mode is selected by pressing the **NAV** button on the mode selector with the navigation receiver tuned to a VOR frequency and less than 20 DME miles from the station. The mode operates identically to the VOR mode with the gains optimized for a VOR approach.

(d) Localizer Mode. The Localizer Mode (LOC) is selected by pressing the **NAV** button on the mode selector with the navigation receiver tuned to a LOC frequency. Mode selection and annunciation in the LOC mode is similar to the VOR mode. The localizer deviation signal is gain programmed as a function of radio altitude, time, and airspeed. If the radio altimeter is invalid, gain programming is a function of glide slope capture, time and airspeed. Other valid logic is the same as the VOR mode.

(e) Back Course Mode. The Back course Mode (BC) is selected by pressing the **BC** button on the mode selector. The normal front course for the localizer beam is set for the selected course. BC operates the same as the LOC mode with the deviation and course signals reversed to make a back course approach on the localizer. When BC is selected, and outside the lateral beam sensor trip point. **BC ARM** and **HDG** will be annunciated on the Mode Selector. At the capture point, **BC CAP** will be annunciated with **BC ARM** and **HDG** extinguished. When BC is selected, the glideslope circuits are locked out.

NOTE

Do not use the FD Approach mode for FMS/GPS approaches.

(f) Approach Mode. The Approach (APR) Mode is used to make VOR, Localizer, and ILS approaches but not FMS/GPS approaches. This mode is more sensitive than the NAV mode.

(g) Localizer Approach Mode. The approach mode is used to make an ILS approach. Pressing the **APR** button with a LOC frequency tuned arms both the localizer and glideslope modes. No alternate NAV source can be selected and the NAV receiver must be tuned to an ILS frequency. When the **APR** button is pressed and the above conditions are met, both the NAV and APR modes are armed to capture the localizer and glideslope, respectively. Operating LOC mode is the same as described above except, if the radio altimeter is invalid in APR mode, gain programming is a function of glideslope capture, time, and airspeed.

With the APR mode armed, the pitch axis can be in any one of the other pitch modes except go-around. When reaching the vertical beam sensor trip point, the system automatically switches to the glideslope mode. The pitch mode and **APR ARM** annunciators extinguish and **APR CAP** annunciator illuminates on the controller. At capture, a command is generated to asymptotically approach the glideslope beam. Capture can be made from above or below the beam. The glideslope gain is programmed as a function of radio altitude, time and airspeed. The **APR CAP** annunciator on the Mode Selector will extinguish if the GS receiver becomes invalid after capture.

Glideslope capture is interlocked so that the localizer must be captured prior to glideslope capture. If the glideslope receiver is not valid prior to capture, the vertical beam sensor will not trip and the system will remain in the pitch mode. After capture, if the NAV receiver, GS receiver, compass data or vertical gyro becomes invalid, command cue will bias out of view. If the radio altimeter is not valid, the glideslope gain programming is a function of GS capture, time, and airspeed.

(h) Pitch Hold Mode. Whenever a roll mode is selected without a pitch mode, the command cue will display a pitch attitude hold command. The pitch attitude can be changed by pressing the **TCS** button on the control wheel and maneuvering the aircraft. The command cue will be synchronized to zero while the button is pressed. Upon release of the button, the pitch command will be such as to maintain the new pitch attitude. In the pitch hold mode, the command cue will be biased out of view if the VG is not valid.

(i) Altitude Hold Mode. The Altitude Hold Mode (ALT) is selected by pressing the **ALT** button on the mode selector. When ALT is selected, it overrides the APR CAP, GA, IAS. VS. ALT SEL CAP. or PITCH HOLD modes. In the ALT mode the pitch command is proportional to the altitude error provided by the air data computer. The altitude error signal is

gain programmed as a function of airspeed. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new Altitude Hold reference without disengaging the mode. Once ALT is engaged, the mode will be reset if the air data computer is not valid and the command cue will bias out of view if the VG is not valid.

NOTE

If the Baro setting on the altimeter is changed, a command is generated to fly the aircraft back to the original altitude reference.

(j) Indicated Airspeed Hold Mode. The Indicated Airspeed (IAS) Hold mode button on the mode selector. When IAS is selected, it overrides the APR CAP, GA, ALT, VS, ALTSEL CAP, or PITCH HOLD modes. In the IAS mode the pitch command is proportional to airspeed error provided by the air data computer. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new Airspeed Hold reference without disengaging the mode. Once engaged in the IAS mode, the mode will be reset if the air data computer is not valid and the command cue will bias out of view if the VG is not valid.

(k) Vertical Speed Hold Mode. The Vertical Speed (VS) Hold mode is selected by pressing the **VS** button on the mode selector. When **VS** is selected, it overrides the APR CAP, GA, ALT, ALTSEL CAP, IAS, or PITCH HOLD modes. In the VS mode, the pitch command is proportional to VS error provided by the air data computer. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new VS reference without disengaging the mode. Once engaged in the VS mode, the mode will be reset if the air data computer is not valid and the command cue will bias out of view if the VG is not valid.

(l) Altitude Pre-select Mode. The Altitude Pre-select Mode (ALTSEL) is selected by pressing the **ALTSEL** button on the mode selector. The desired altitude is selected on the altitude pre-select controller. Pitch hold, VS, or IAS may be selected as a mode to fly to the selected altitude. When outside the altitude bracket trip point, the **ALT SEL ARM** annunciator along with the selected pitch mode is illuminated on the mode selector. When reaching the bracket altitude, the system automatically switches to the ALTSEL CAP mode and the previously selected pitch mode is cancelled. At bracket, a command is generated to asymptotically capture the selected attitude. When the altitude is reached, the ALT SEL CAP mode is automatically cancelled and the FD switches to the ALT hold mode. If the air data computer is not valid, the ALTSEL cannot be selected. The command cue will bias out of view if the VG is not valid.

(m) Standby Mode. The Standby (SBY) mode is selected by pressing the **SBY** button on the mode selector. This resets all the other flight director modes and biases the command cue from view. While pressed, SBY acts as a lamp test causing all mode annunciators to illuminate and the flight director warning flag on the EADI to come in view. When the button is released, the mode annunciator lights extinguish and the flight director warning flag retracts from view.

(n) Go-Around Mode. The Go-Around (GA) mode is selected by pressing the remote go-around switch. When selected, all other modes are reset and the remote **GA** annunciator is illuminated. The command cue receives a wings level command (zero command when roll is zero). The command cue also receives the go-around command which is a 7° pitch up attitude command. Selecting GA disconnects the autopilot. The yaw damper remains on.

Once go-around is selected, any roll mode can be selected and will cancel the wings level roll command. The go-around mode is cancelled by selecting another pitch mode or TCS.

e. Autopilot Controller. The Autopilot Controller provides the means of engaging the autopilot and yaw damper as well as manually controlling the autopilot through the turn knob and pitch wheel, Figure 3B-15. The autopilot system limits are provided in Table 3B-7.

(1) Pitch Wheel. Movement of the pitch wheel will cancel only ALT HOLD and ALTSEL CAP. With vertical modes of VS or IAS selected on the mode selector, rotation of the pitch wheel will change the respective displayed vertical mode reference. VS or IAS mode may be canceled by pressing the mode button on the mode selector. If VS or IAS are not selected, the pitch wheel works as described above. The pitch wheel is always disabled during a coupled glide slope.

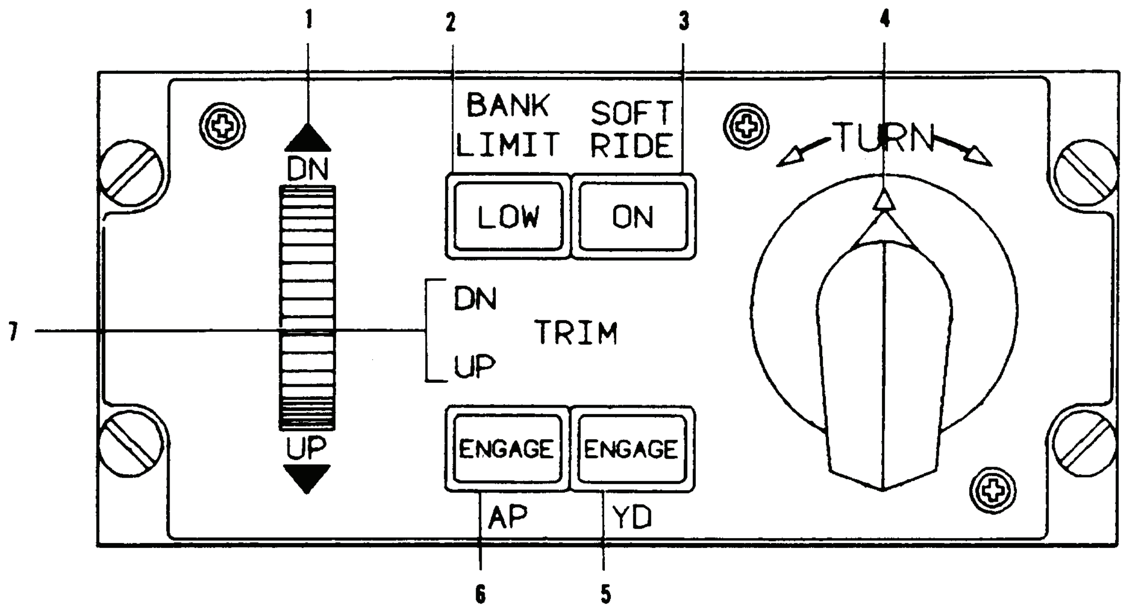
(2) Bank Limit. Selection of the Bank Limit mode on the autopilot controller provides a lower maximum bank angle while in the Heading Select (HDG) mode. **LOW** will illuminate on the **BANK LIMIT** switch. The lower bank limit is inhibited and **LOW** is extinguished during NAV mode captures. If HDG is again engaged, **BANK LIMIT** will again be illuminated. Pressing **BANK LIMIT** when illuminated will return autopilot to normal bank limits.

(3) ***SOFT RIDE*** *Push Button.* Soft ride reduces autopilot gains while still maintaining stability in rough air. This mode may be used with any F/D mode selected.

(4) ***TURN*** *Knob.* Rotation of the turn knob out of detent results in a roll command. The roll angle is proportional to and in the direction of the turn knob rotation.

(5) ***YD ENGAGE*** *Push Button.* When the autopilot is not engaged, the yaw damper may be utilized by pressing the **YD ENGAGE** push button.

(6) ***AP ENGAGE*** *Push Button*. The engage switch is used to engage the autopilot. Engaging the autopilot automatically engages the yaw damper. The autopilot may be engaged with the aircraft in any reasonable attitude. Refer to Table 3B-7 for autopilot system limits. Autopilot is normally disengaged by momentarily pressing the control wheel **AP DISC** switch. Autopilot may also be disengaged by any of the following methods.



1. **Pitch Wheel**
2. **Bank Limit Selector / Light**
3. **Soft Ride Push Button**
4. **Turn Knob**
5. **Yaw Damp Engage Push Button**
6. **Autopilot Engage Push Button**
7. **Elevator Trim Annunciator.**

Figure 3B-13. Autopilot Controller

1. Actuation of the control wheel **AP DISC** button. Disengagement is confirmed by flashes of the **AP ENG** annunciator.

2. Pressing the respective vertical gyro **FAST ERECT** button.

3. Actuation of respective compass **INCREASE / DECREASE** switch.

4. Selection of Go-Around mode. Disengagement is confirmed by the **AP ENG** annunciator flashing five times and illumination of the **GA** annunciators.

5. Pulling the autopilot **AP CONTROL** circuit breaker.

6. Pressing the autopilot **AP ENGAGE** push button.

7. When transferring between pilot and copilot flight directors.

Any of the following malfunctions will cause the autopilot to automatically disengage.

1. Vertical gyro failure.

2. Directional gyro failure.

3. Autopilot power or circuit failure.

4. Torque limiter failure.

Disengaging under any of the last four conditions will illuminate the **AP DISC** annunciator and the flashing **MASTER WARNING** light. Pressing the control wheel **AP DISC** switch will extinguish the **AP DISC** annunciator.

(7) Elevator Trim Annunciator. The elevator trim annunciator indicates **UP** or **DN** when a sustained signal is being applied to the elevator servo. The annunciator should not be illuminated before the autopilot is engaged.

Table 3B-7. Autopilot System Limits

MODE	CONTROL OR SENSOR	PARAMETER	VALUE
Yaw Damper	Yaw Control	Engage Limit	Unlimited
AP Engage		Engage Limit	Roll Up ± 90°
			Pitch Up to ± 30°
Basic AP	Touch Control Steering	Roll Control Limit	Up to ± 45° Roll
		Pitch Control Limit	Up to ± 20° Pitch
	Turn Knob	Roll Angle Limit	± 30°
		Roll Rate Limit	± 15°/Sec
	Pitch Wheel	Pitch Angle Limit	± 15° Pitch
	Heading Hold	Roll Angle Limit	Less than 6° and no roll mode selected
Heading Select	Heading SEL	Roll Angle Limit	± 25°
	Knob on HSI	Roll Rate Limit	± 3.5°/Sec
		CAPTURE	
VOR	Course Knob, NAV Receiver and DME Receiver	Beam Angle Intercept (HDG SEL)	Up to ± 90°
		Roll Angle Limit	± 25°
		Course Cut Limit at Capture	± 45° Course
		Capture Point	Function of Beam, Beam Rate, Course Error, and DME Distance
		ON COURSE	
		Roll Angle Limit	± 13° Roll
		Crosswind Correction	Up to ± 45° Course Error
		OVER STATION	
		Course Change	Up to ± 90°
		Roll Angle Limit	± 17°
		LOC CAPTURE	
LOC or APR or BC	Course Knob and NAV Receiver	Beam Intercept	Up to ± 90°
		Roll Angle Limit	± 25°
		Roll Rate Limit	± 5°/Sec

Table 3B-7. Autopilot System Limits (Continued)

MODE	CONTROL OR SENSOR	PARAMETER	VALUE
		Capture Point	Function of Beam, Beam Rate, and Course Error
		NAV ON-COURSE	
		Roll Angel Limit	± 17° Roll
		Crosswind Correction Limit	± 30° of Course Error
		Gain Programming	Function of Time and (TAS) starts at 1200 ft radio altitude
		GLIDESLOPE CAPTURE	
LOC or APR or BC	GS Receiver and Air Data Computer	Beam Capture	Function of beam and beam rate
LOC or APR or BC (Cont.)		Pitch Command Limit	± 10
		Glideslope Damping	Vertical Velocity
		Pitch Rate Limit	Function of (TAS)
		Gain Programming	Function of Time and (TAS) Starts at 1200 ft radio altitude
			Function of Radio Alt Starts at 250 ft
GA	Control Switch on Power Lever	Fixed Pitch-Up Command, Wings Level	7° Pitch Up
Pitch Sync	TCS Switch on Control Wheel	Pitch Attitude Command	± 20° Max
ALT Hold	Air Data Computer	ALT Hold Engage Range	0 to 50,000 ft
		ALT Hold Engage Error	± 20 ft
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)
VS Hold	Air Data Computer	VERT Speed Engage Range	0 to ± 6000 ft/min
		ALT Speed Hold	± 30 ft
		Engage Error	
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)
IAS Hold	Air Data Computer	IAS Engage Range	80 to 450 knots
		IAS Hold Engage Error	± 5 knots
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)
ALT Pre-select	Air Data Computer	Pre-select Capture Range	0 to 50.000 ft
		Maximum Vertical Speed for Capture	± 4000 ft/min
		Maximum Gravitational Force During Capture Maneuver	± .2g
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)

f. Touch Control Steering. The Touch Control Steering (**TCS**) push button on the control wheel allows the pilot to manually change aircraft attitude, altitude, vertical speed and/or airspeed without disengaging the autopilot. After completing the manual maneuver, the **TCS** push button is released and the autopilot is automatically resynchronized to the vertical mode: e.g., with IAS mode selected, the pilot may press the **TCS** push button and manually change airspeed. Once trimmed at the new airspeed, the **TCS** push button is released and the autopilot will hold this airspeed. If a large pitch attitude change is made, the pilot should perform his normal trim of the aircraft before releasing the **TCS** button.

NOTE

Either pilot's TCS button will permit changing of the autopilot regardless of which pilot has control of the autopilot. Also, use of the TCS will cancel the pilot's flight director GA mode.

3B-18. FMS-800 FLIGHT MANAGEMENT SYSTEM.

a. Description.

(1) System Overview. The FMS-800 flight management system provides global autonomous guidance using GPS navigation. This FMS guidance may be used to fly published airways, direct routing, TACAN emulation procedures, and published non-precision or autonomous GPS approaches, as well as various mission patterns.

The FMS-800 permits pre-flight loading of 40 complete mission plans using a data cartridge. It also permits the crew to generate or modify mission plans on the aircraft, using a global International Civil Aviation Organization (ICAO) data base of waypoints and automatic flight plan calculations.

The FMS-800 also provides simplified crew control of the communication radios.

NOTE

The C-12 installation utilizes a single Control Display Unit (CDU).

This section contains the basic procedures to operate the FMS-800 flight management system. The paragraphs are organized as follows, with each paragraph providing the procedures necessary to use that corresponding function.

(2) System Architecture. Figure 3B-16 shows a simplified diagram of the FMS-800 system. The CDU provides access to all system functions for a single crew member. It also provides user interface between the FMS-800 and MIL-STD-1553B and non-1553B aircraft systems.

The data cartridge is used to load mission data and to act as an in-flight library of ICAO waypoints. It also loads the current worldwide magnetic variation tables automatically upon power-up and can be used to load or store GPS almanac data to reduce GPS cold start time following installation of a GPS receiver.

NOTE

A lithium battery is installed in the CDU to reduce the initialization time.

The MIL-STD-1553B multiplexed serial digital data bus is the primary means of control and data Transferal within the FMS-800. This bus has the following characteristics:

1. Dual data paths (buses) between each remote terminal and the bus controller.

2. No operator actions required for initialization or any other aspect of normal bus controller operation.

The CDU operates on the MIL-STD-1553B data bus as a Bus Controller (BC). The CDU that is functioning as bus controller performs all navigation and guidance computations, builds all page displays, communicates with all external equipment and performs all other computations required to support FMS-800 operation.

b. CDU Operations.

(1) General Operation Concepts. CDU data entry operations are performed with a full alphanumeric keypad, arrow keys, function keys, and eight line select keys, Figure 3B-17. The CDU display has 8 lines of 22 characters each. Lines 1, 3, 5, and 7, are data lines with a line select key on both the right and left of the field. Line 2 is reserved for page title and line 6 is reserved as an annunciation line. Line 4 is an unreserved data line and line 8 is the scratchpad for holding all keypad entries. See Table 3B-8 for the descriptions of the CDU's function and application keys.

NOTE

The character set displayed in Figure 3B-17 does not represent the actual view on the CDU screen.

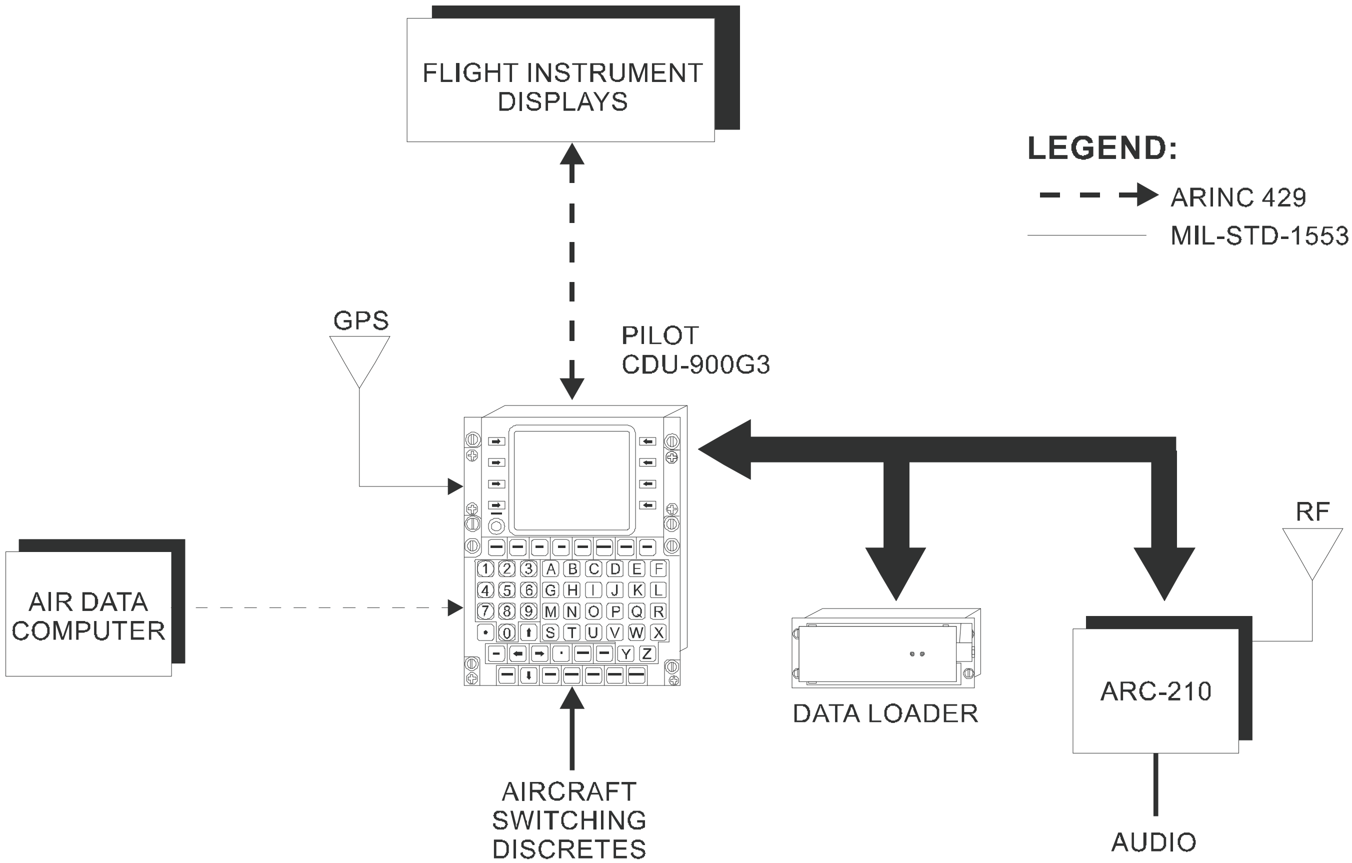


Figure 3B-14. FMS-800 Simplified Diagram

1. Line Select Keys
2. Function Keys
3. Function Keys
4. Clear Key
5. Scroll Keys

Figure 3B-15. Control Display Unit Front Panel

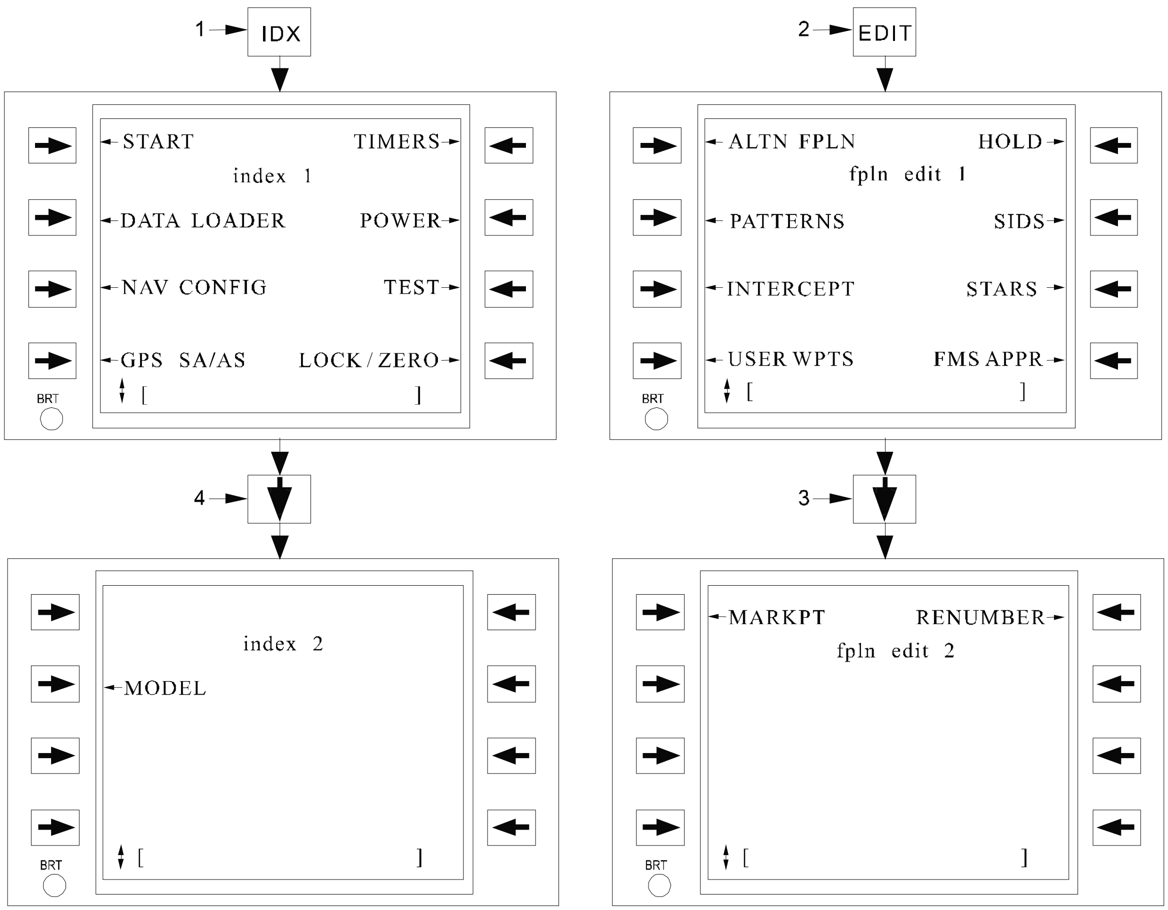
Table 3B-8. FMS-800 CDU Function and Application Keys

FUNCTION KEYS			
KEY	**DESCRIPTION**	**KEY**	**DESCRIPTION**
COM	Accesses control pages for UHF/VHF radio.	**M3**	Function not used.
DATA	Enables display of expanded data for any selected waypoint.	**MARK**	Marks and stores present position plus any active cursor position transmitted from the Flight Display System (FDS).
DIR	Enables immediate selection of Direct-To waypoint.	**MSN**	Accesses a menu of additional mission functions.
EDIT	Accesses Flight Plan pages.	**NAV**	Accesses the Navigation information page.
FPLN	Accesses Flight Plan pages.	**PSN**	Accesses Pilot Position (present position and track) pages.
IDX	Accesses index of additional functions not available on top-level keys.	**STAT**	Accesses avionics LRU status pages.
IFF	Function not used.	**STR**	Accesses Pilot Steering pages.
INAV	Accesses comprehensive data pages for GPS navigation solutions.		
APPLICATION KEYS			
–	Deletes data from entry fields or causes data to revert to a default value.	↓	Scrolls vertically to related pages of data or scrolls down through lists of data on a page.
CLR	Clears the scratchpad of incorrect entries or annunciations.	→	Horizontally scrolls right to access additional pages of information.
/	Separates the waypoint identifier, bearing, and distance components.	←	Horizontally scrolls left to access additional pages of information.
↑	Scrolls vertically to related pages of data or scrolls up through lists of data on a page.		

(a) Scratchpad. The scratchpad is a buffer to hold all data for review prior to executing the input. As data is keyed into the CDU with the keypad, the entered values are displayed within the scratchpad field at the bottom of the display. Incorrect entries are cleared with the **CLR** key. A single press clears the last character on the right. Holding the **CLR** key down clears the entire scratchpad. The scratchpad is cleared automatically when the system accepts valid inputs.

(b) Function Keys. The labeled function keys are used to call up specific top-level pages of the CDU and to simultaneously dedicate the line select keys to the functions indicated on that page. Exceptions are the **MARK** and **DATA** keys that do not change the page but do initiate their respective functions. Some functions which are less frequently used in flight are accessed through the index (**IDX**) and flight plan edit (**EDIT**) function keys and then via line select keys on the respective menu page. The Index and Flight Plan Edit pages are shown in Figure 3B-18.

(c) Line Select Keys. Line select keys can be used to access lower level pages, toggle modes of the function, enter data in the associated field, or copy data in the scratchpad. When undefined line select keys are pressed, no operation is performed and no annunciation is displayed.



1. **Press IDX function key to access Index page.**
2. **Press EDIT function key to access Edit page.**
3. **Scroll to access Edit 2 page.**
4. **Scroll to access Index 2 page.**

Figure 3B-16. Index and Flight Plan Edit Pages

When a label next to the line select displays an outward-pointing arrow, selecting the line select will access the page identified by the line select label.

When a colon is displayed next to a line select label, selecting the line select will toggle the label value to a different state. When two labels are shown, the toggled value is the innermost label or value.

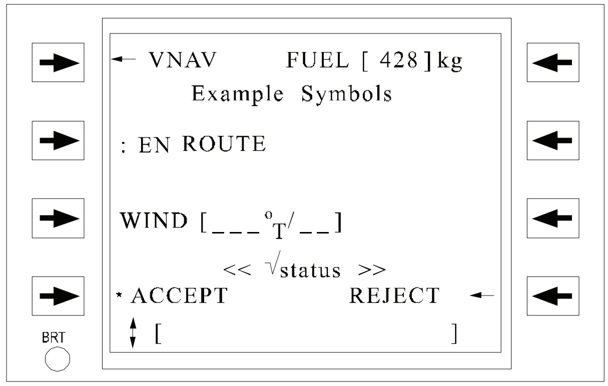
When brackets ([ ]) are displayed next to a line select, selection of the line select with valid data in the scratchpad will enter the data into the bracketed field and enable use of that data by the FMS. When the scratchpad is blank, selection of the line select next to the bracketed data will copy that data to the scratchpad.

When a label next to a line select displays an inward pointing arrow, selecting this line select will either select, enable, or disable the indicated function or item. For single step functions, an asterisk to identify the function as enabled will replace the arrow. When multiple selections are needed prior to activation of the function, a "fat" arrow to highlight the selection will replace the arrow. When all selections are made, an asterisk will replace the fat arrow when the function is enable.

Symbolic aids are used to indicate what entries can be made, what functions are on or engaged, and what selections are possible. Refer to Figure 3B-19 for a summary of these symbols.

NOTE

The lateral and vertical scroll arrows are located next to the scratchpad on the display.



←→ Pushing the line select key will access the page indicated by the label.

→← Pushing the line select key will select the item or enable the mode.

⇒⇐ Function is selected, but not enabled.

★ Function is on or enabled.

: Alternate selection among modes (toggle).

° Reference is degrees magnetic north.

°T Reference is degrees true (indicated by "T" symbol).

√ Check (as in check status for equipment failures).

– – – No computed data is available or meaningful, or power is off.

[ ] Data entry is possible / required.

↕↑↓ Vertical page or line scrolling is possible (in direction of arrow).

←→ Lateral page scrolling is possible (in direction of arrow).

Lateral and vertical page scrolling is possible.

Figure 3B-17. CDU Standard Display Symbols

(d) Display Scrolling. Often more data is available than what fits on a single display page. In these cases display scrolling is used to access all the related information.

Two types of scrolling are page scrolling and line scrolling. Vertical scrolling with up (↑) and down (↓) arrows either accesses additional pages of the information shown or scrolls through lists of data. Horizontal scrolling with left (←) or right (→) arrows accesses additional pages of similar information.

Holding the arrow keys causes the scrolling to continue until the key is released. Special characters (horizontal double-headed arrow, vertical double-headed arrow, and multi-headed arrow) are displayed next to the scratchpad to indicate the type of scrolling.

(e) Confirmation Function. Functions that involve destruction of significant internal data require confirmation before execution. A message, CONFIRM XXX, will appear in the scratchpad, where XXX is a message unique to the item requiring confirmation. The scratchpad message is cleared by either reselecting the appropriate line select key to confirm the selection or by pressing the **CLR** key if the function is not desired.

(f) Copying and Transferring Data. Most data to be entered on the CDU can be copied into the scratchpad in its original form by pressing the adjacent line select key, except where other operations are performed which take precedence. Once copied into the scratchpad, this data may be transferred elsewhere in the FMS-800. For example, a waypoint may be transferred from the mark point list to the flight plan, or the flight plan waypoint sequence may be reordered without having to re-enter the waypoint data.

(2) Data Entry and Display Formats. The acceptable entry formats, valid data ranges, and display formats are discussed in the following paragraphs. They are applicable to all CDU pages unless stated otherwise. On many CDU pages,

configuration settings and entered data are maintained through each power cycle to maintain continuity between aircraft sorties. Also, a lot of data is maintained in the event of a bus controller swap.

(a) Valid Data Ranges and Units for Entry and Display. Data entry valid ranges for a given field are generally limited by the display resolution with assumption of a fixed decimal point and positive entries (i.e., a four-digit numerical field with no decimal point will accept entries from 0 to 9999). Some entered data is limited by operational considerations, e.g., VNAV angle of 6.0° or 3500 fpm maximum. For values which cannot be computed due to insufficient data, the CDU will display dashes (– – – –); e.g., if gross weight cannot be computed by the FMS because total fuel has not been specified. Asterisks (****) are displayed if the value is too large for its respective display field.

(b) Entry and Display of Waypoints. Flight plan waypoints and other locations are entered in three basic formats:

<u>1</u> *Position Coordinates.* Latitude-longitude waypoint pair.

<u>2</u> *Waypoint Identifier.* Up to five character alphanumeric string. The appropriate data is extracted from an on-board ICAO waypoint database or user defined waypoint list of navigation aids, airports, intersections, etc.

<u>3</u> *Identifier / Bearing / Distance.* Position defined at the specified bearing and distance from a database waypoint with the indicated identifier.

(c) Entry and Display of Latitude-Longitude Waypoints. Latitude-longitude waypoints are entered in the form of degrees and minutes followed by optional decimal minutes or seconds and decimal seconds. The required format is an N or S followed by four or six digits, with a decimal point and up to three additional digits optional. Then followed by E or W with five or seven digits, with a decimal point and up to three additional digits optional.

Latitude-longitude waypoints are displayed as whole minutes on all CDU pages except in the scratchpad when the value is copied and on the Position, Integrated Navigation, Start 1, or Data pages where thousandths of minutes are displayed.

(d) Entry and Display of Identifier Waypoints. Identifiers are entered as up to five alphanumeric. Identifier waypoints are displayed left justified, with alphabetic characters always written as capital letters. Crew-entered identifiers are limited to between two and five characters. Single character identifiers cannot be entered by the crew and are only accessed by inserting a SID, STAR, or approach that includes such a waypoint in the procedure.

(e) Entry and Display of Identifier/ Bearing/Distance Waypoints. Identifier/bearing/ distance waypoints are entered as an identifier followed by a / , followed by the bearing, followed by a / , followed by distance. Bearings are entered as three digits optionally followed by a decimal point and an additional digit. Bearing is displayed as three digits rounded to the nearest degree. An entry of 145.3° will be displayed as 145°. In the case of a number such as 145.5°, the CDU always rounds up to the nearest whole number. Distances are entered as up to four digits optionally followed by a decimal point and one additional digit.

When a bearing/distance is applied to a waypoint, the waypoint will appear as one of the following:

1. If the waypoint is an ICAO identifier and the distance is 999 nm or less, the waypoint will be displayed as identifier/bearing/ distance (e.g. EDW/350/45).

2. If the waypoint is not a waypoint identifier or the distance is greater than 999 nm, the waypoint will be displayed as latitude/longitude.

(f) Use of Magnetic Variation and Declination. Magnetic variation is used in converting most azimuth angles from true to magnetic reference. Courses into navaid waypoints and any offset waypoints described relative to these waypoints use stored station declination rather than magnetic variation in the computations, so that they match those on published Instrument Flight Rules (IFR) charts.

(g) Entry and Display of Time and Date. Time is entered with no delineators between hours, minutes, and seconds. Seconds are optional, so that three to six digits are acceptable. If no time or date is available for a given field, blanks are displayed. All times are entered and displayed as Coordinated Universal Time (UTC). Dates are entered and written using the military convention of day, month, year (six digits total). Example would be 16/12/97 (December 16, 1997).

The FMS-800 system has been designed to avoid date and time rollover problems. The operator will not see problems if a current date and time are entered into the CDU prior to initializing GPS modules.

(h) Deletion of Data. Most data entry fields may have the associated data deleted by entering a **–** in the scratchpad and pressing the line select adjacent to the desired field. In some cases, the dash entry causes the data to revert to a fixed default value (e.g., wind to 360º/0).

(3) System Annunciations and Scratchpad Messages. The CDU will alert the crew of avionics failures, degraded operations, system modes of operation or operator entry errors via the CDU annunciation line and scratchpad. The following three methods are used:

1. Annunciations on the annunciation line of the CDU.
2. Scratchpad messages only displayed locally on the CDU causing the condition.
3. Master CDU alert annunciation is provided as an external alert in the pilot's primary field of view.

Table 3B-9 provides a list of CDU annunciations and scratchpad messages.

The scratchpad messages are displayed in uppercase letters. Some of the messages alternate with the entered data that caused the message. If a scratchpad message is simultaneously displayed with data, the first **CLR** key activation will clear the scratchpad message and the next **CLR** will clear the scratchpad.

Annunciations are displayed in lowercase letters. The annunciation line displays only a single annunciation at a time; however, a + marker will appear to indicate when multiple annunciations are present. The priority of annunciations is shown in Table 3B-10. The + flashes whenever an unacknowledged and lower priority annunciation is generated. Annunciations are acknowledged by pressing the **CLR** key and cycling through the currently active annunciations.

Additionally, the chart indicates if the annunciation is non-clearable and if the CDU master alert annunciation is also set by the associated condition. For clearable annunciations, use the **CLR** key to clear. If data or scratchpad messages are in the scratchpad, the **CLR** key will first clear the scratchpad before clearing the annunciation line.

Table 3B-10 shows the priority of the CDU annunciations (highest priority at top of list).

Table 3B-9. CDU Annunciations and Scratchpad Messages

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
ACTIVE CHANNEL	Attempting to perform an ERF on a hopset that is the currently tuned preset on the V/UHF.	Clear key	SP	A		
ADD ALTN BEFORE?	An alternate flight plan has been selected to be added to the flight plan.	Clear key or insertion of the alternate flight plan into the flight plan.	SP	N		
ALTN FPLN FULL	Attempt to insert more than 60 legs into the alternate flight plan.	Clear key	SP	A		
ANTI JAM MISMATCH	Attempt to tune to an anti-jam preset that contains a Have Quick net when the V/UHF's preset contains a SINCGARS net, and vice versa.	Clear key	SP	A		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
approach	Given for the following conditions: 1. For a GPS approach mode, 10 seconds after flashing **APPROACH** annunciation is activated and the HSI deviations and RAIM Integrity performance are set for approach mode. 2. Flight sequence mode transitions or manually selected to approach and the 10 second flashing **APPROACH** annunciation is not active.	HSI deviations change to terminal, en route, or oceanic mode.	A	N	X	
approach	Following flashing approach annunciation or when Flight Mode transitions or manually selected to approach mode. HSI deviations and RAIM integrity performance are set for approach.	Ten seconds after initiation or HSI deviations change to terminal, enroute, or oceanic mode.	A	B	X	
APPROACH DEFINED	Attempt to: 1. Enter a VNAV parameter at the MAP or visual runway extension waypoint. 2. Delete the V attribute at the MAP of an approach or the RWXND waypoint of a visual approach. 3. Attach a Hold to an IAF (with a database holding pattern), MAP, or Missed Approach Holding Point (with a database holding pattern). 4. Attach a pattern to an IAF, (with a database holding pattern), FAF/runway extension point, MAP, or Missed Approach Holding Point (with a database holding pattern).	Clear key	SP	A		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
	5. Insert an offset when approach waypoint is the active waypoint. 6. Enter a waypoint between the FAF/ runway extension point and MAP. 7. Perform a direct-to the MAP. 8. Enter an approach into the flight plan when an approach is already inserted					
APPROACH IS ACTIVE	Attempt to: 1. Delete or remove the approach from the flight plan during execution (MAP is the active waypoint). 2. Modify the flight plan course, approach parameters, or (before the MAP is passed) the sequencing mode when a MAP is the active waypoint. 3. Insert a PPSN hold or insert a waypoint at the active waypoint when the MAP is the active waypoint.	Clear key	SP	A		
ATTACH CIR AT?	A circle pattern without a defined fix has been selected for insertion into the FPLN or alternate flight plan.	Clear key or valid insert.	SP	N		
ATTACH CRP AT?	A closed random pattern without a defined fix has been selected for insertion into the FPLN or alternate flight plan.	Clear key or valid insert.	SP	N		
ATTACH FG8 AT?	A figure 8 pattern without a defined fix has been selected for insertion into the FPLN or alternate flight plan.	Clear key or valid insert.	SP	N		
ATTACH HOLD AT?	A hold has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
Attach RTK AT?	A racetrack pattern without a defined fix has been selected for insertion into the FPLN or alternate flight plan.	Clear key or valid insert.	SP	N		
CARTRIDGE IN USE	Attempt to access the data cartridge while data is currently being up/down loaded.	Clear key	SP	A		
√bank limit	Bank limit is less than 25° and a refuel pattern is activated, or a holding pattern fix is passed for the first time, or within 30 nm of the FAF/runway extension point or airport for the first time.	Clear key	A	B		
√baroset	Within 30 nm of the FAF/runway extension point for the first time.	Clear key or entering a BARO set on the pilot or copilot vertical steer page.	A	B		
√gps	Loss of GPS use as an INAV source (5 second filter while in approach sealing mode, 25 second filter while in oceanic, enroute or terminal scaling modes).	Clear key or re-obtaining GPS or selecting an INU only INAV solution.	A	B		
√IFF2	Attempt to set IFF #1 to normal power mode when IFF #2 is active.	Clear key	SP	A		
√nav error	Downgrade in 95% probable error.	Clear key or upgrade in position index.	A	B		X
√POWER	Attempt to control modes of equipment when power is disabled on power page.	Clear key	SP	A		
√speed	During a TNAV, ground speed, (or IAS for pattern) deviates from the guidance solution's groundspeed (or IAS for pattern) by the designated amount entered on the Navigation Configu-ration page (3 second filter).	Correction in airspeed or clear key.	A	B		X
√status	Detected failure of an LRU or interface signal (3 second filter).	Clear key or selection of the STAT key.	A	B		X
√STATUS	A request for display or operation that cannot be provided due to failure or the LRU is under test.	Clear key	SP	A		
√timer 1	Down-count to zero.	Clear key	A	B		X

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
√timer 2	Down-count to zero.	Clear key	A	B		X
√timer 3	Down-count to zero.	Clear key	A	B		X
√version	CDU software versions incompatible.	Replace or power down unit with incorrect version.	A	B	X	X
cir active	Circle pattern is currently being executed.	Circle pattern canceled.	A	N	X	
CIR IS ACTIVE	Attempt to delete or modify the circle fix, delete MFP attribute, or modify the flight plan course or attempt to insert a PPOS hold or insert a waypoint at the active waypoint during pattern execution.	Clear key	SP	A		
CONF LOADXXXXXXXX	Request to load the alternate flight plan XXXXXXXX into the CDU from the data cartridge.	Clear key, reselect entered ALTN.	SP	N		
CONFIRM ADD	Request to add a new user waypoint to the database.	Clear key, or select Add.	SP	N		
CONFIRM ALTN RMV	Request to remove a Pattern from the alternate flight plan.	Clear key or reselect ALTN FPLN.	SP	N		
CONFIRM CHNG TO CIR	Request to change MFP type to circle.	Clear key or selection of PTRN CHNG.	SP	N		
CONFIRM CHNG TO FG8	Request to change MFP type to figure 8.	Clear key or selection of PTRN CHNG.	SP	N		
CONFIRM CHNG TO RTK	Request to change MFP type to racetrack.	Clear key or selection of PTRN CHNG.	SP	N		
CONFIRM CLEAR COMM	Request to clear COMM presets.	Clear key or reselect COMM.	SP	N		
CONFIRM CLEAR FPLNS	Request to clear flight plan and alternate flight plans.	Clear key or reselect FPLN/ALTN.	SP	N		
CONFIRM CLEAR GPS	Request to clear GPS SA/AS keys.	Clear key or reselect GPS	SP	N		
CONFIRM CLEAR PTS	Request to clear the markpoint and waypoint list.	Clear key MKPTS/WPTS.	SP	N		
CONFIRM ERASE DATA	Request to erase flight data (Start 3 page).	Clear key or reselect ERASE FLT/DATA.	SP	N		
CONFIRM ERASE ALTN	Request to erase alternate flight plan (Altn Fpln page).	Clear key or reselect ERASE ALTN.	SP	N		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
CONFIRM ERASE FPLN	Request to erase flight plan (Start 3 page).	Clear key or reselect ERASE FPLN.	SP	N		
CONFIRM FPLN RMV	Request to remove a Hold, FMS approach, SID, STAR, Pattern or Intercept from the flight plan.	Clear key or reselect FPLN RMV.	SP	N		
CONFIRM HOLD PPSN	Request to hold at present position.	Clear key reselect HOLD PPSN.	SP	N		
CONFIRM LOAD ALMNAC	Request to load the GPS almanac data.	Clear key or reselect LOAD ALMANAC.	SP	N		
CONFIRM LOAD ALTN	Request to load the alternate flight plan into the CDU from the data cartridge.	Clear key, reselect LOAD, or reselect entered altn.	SP	N		
CONFIRM LOAD COMM	Request to load COMM data into the CDU from the data cartridge.	Clear key or reselect LOAD COMM.	SP	N		
CONFIRM LOAD DATA	Request to load flight data (Start 3 page).	Clear key or reselect LOAD FLT/DATA.	SP	N		
CONFIRM LOAD PTS	Request to load markpoint and waypoint lists into the CDU from the data cartridge.	Clear key or reselect LOAD MKPT/WPT.	SP	N		
CONFIRM OVERWRITE	Request to replace existing information on the user waypoint database.	Clear key or select Add.				
CONFIRM POWER OFF	Request to turn off power to all IFF and Nav/Com radios.	Clear key or reselect Radio Master.	SP	N		
CONFIRM RENUMB FPLN	Request to renumber the flight plan.	Clear key or reselect RENUMBER.	SP	N		
CONFIRM RPLACE FPLN	Request to replace the flight plan with the alternate (Start 3 and Altn Fpln pages).	Clear key or reselect REPLACE FPLN.	SP	N		
CONFIRM RVRSE ALTN	Request to reverse the alternate flight plan.	Clear key or reselect RVRS ALTN.	SP	N		
CONFIRM SAVE ALMNAC	Request to save the selected GPS almanac data.	Clear key or reselect SAVE ALMANAC.	SP	N		
CONFIRM SAVE ALTN	Request to save the alternate flight plan to the data cartridge.	Clear key or reselect SAVE.	SP	N		
CONFIRM SAVE COMM	Request to save COMM data into the data cartridge from the CDU.	Clear key or reselect SAVE COMM.	SP	N		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
CONFIRM SAVE PTS	Request to save markpoint and waypoint lists to the data cartridge.	Clear key or reselect SAVE MKPT/WPT.	SP	N		
CONFIRM SAVE STATUS	Request to save markpoint and waypoint lists to the data cartridge.	Clear key or reselect SAVE STAT.	SP	N		
CONFIRM SID RPLACE	Request to replace a SID in the flight plan.	Clear key or reselect the line select key.	SP	N		
CONFIRM STAR RPLACE	Request to replace a STAR in the flight plan.	Clear key or reselect the line select key.	SP	N		
CONFIRM SYSTEM TEST	Request to initiate test on all LRUs controlled by FMS-800.	Clear key or reselect SYSTEM.	SP	N		
CONFIRM UPDATE AJ	Attempting to update the CNMS antijam preset list with the V/UHF antijam preset list.	Clear key or reselect UPDATE AJ PRESETS.	SP	N		
CONFIRM ZERO ALL	Request to zeroize the system.	Clear key or reselect ZERO ALL.	SP	N		
crp active	Closed random pattern is currently being executed.	Closed random pattern canceled.	A	N	X	
CRP IS ACTIVE	Attempt to delete or modify the closed random pattern fix or delete MFP attribute or modify the flight plan course or attempt to insert a PPOS hold or insert a waypoint at the active waypoint during pattern execution.	Clear key	SP	A		
CRS CHANGE >90	Attempt to apply course edit greater than 90 degrees from the current inbound course while in automatic or flyover leg sequence mode.	Clear key	SP	A		
crs reversal	Generated at 3 nm from a course reversal procedure execution.	Enabling the holding pattern at the TO or switched to capturing inbound leg of course reversal or sequencing by the FAF or IAF.	A	N	X	
CRS RVRSL IS ACTIVE	Attempt to delete the active waypoint, modify the flight plan course, or attempt to insert a PPSN hold or insert a waypoint at the active waypoint during course reversal execution.	Clear key	SP	A		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
data expired	Current date is greater than the database effective period.	Clear key or new database.	A	N		X
DATA FOR?	Prompt for access to Data page.	Clear key or valid waypoint selection.	SP	N		
DIRECT TO CRP?	Access of CRP page from the Direct - To Flight Plan page.	Clear key or selection of CRP point for Direct-To Flight Plan page.	SP	N		
DISCONTINUITY	Attempt to enter a course to waypoint when a discontinuity is the active waypoint.	Clear key	SP	A		
discontinuity	A discontinuity is the active waypoint.	Delete the dis-continuity, delete the associated waypoint, insert a waypoint between the discontinuity and the associated way-point, or direct-to any waypoint.	AL	N		
DUPLICATE USER WPT	Attempt to assign a user waypoint identifier with the **/** function when the same identifier already exists in the User Waypoint List.	Clear key	SP	A		
ELEMENT OMITTED	Attempt to initiate MWOD LOAD or FMT LOAD when the entered list is not complete.	Clear key	SP	A		
EMER/GUARD ENGAGED	Attempt to change COMM modes when set to emergency configuration.	Clear key	SP	A		
ENTER ANGLE OR RATE	Attempt to toggle between CLIMB and DESCNT when no vertical angle or rate has been entered.	Clear key	SP	A		
ENTER DATE	Attempt to verify a date is in the V/UHF when there is no date entered on the CDU.	Clear key	SP	A		
ENTER FIX	Attempt to enter a magnetic track or toggle to a magnetic track when a target fix has not been entered on the Intercept A page.	Clear key	SP	A		
ENTER PARA-METERS	Attempt to insert an intercept, MFP, or approach into the flight plan when defining parameters have not been entered.	Clear keys	SP	A		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
enter utc	On power up if time is not available and crew has not entered time or if bus control is switched with time not valid.	Clear key or entry of time or return of valid time.	A	N		
ENTER UTC/DATE	Attempt to start one of the times without a valid UTC and Date available in system.	Clear key	SP	A		
ENTER WAYPOINT	Attempt to enter an alternate flight plan parameter prior to entering the waypoint or attempt to enter a flight plan course when no TO exists.	Clear key	SP	A		
ERF IN PROCESS	Attempt to initiate another action on the V/UHF when an ERF is in process.	Clear key	SP	A		
exiting hold	Active hold is canceled by deletion of the H attribute.	Hold fix is crossed.	AL	N		
fg8 active	Figure 8 pattern is currently being executed.	Figure 8 pattern canceled.	A	N	X	
FG8 IS ACTIVE	Attempt to delete or modify the figure 8 fix; delete MFP attribute, modify flight plan course, insert a PPSN hold, or insert a waypoint at the active waypoint during pattern execution.	Clear key	SP	A		
FINAL APPR CRS XXX°	Direct-To is made to the FAF of an approach.	Clear key or selecting CRS entry on the Flight Plan page.	SP	N		
FL005 FT MINIMUM	Attempt to enter VNAV or alternate flight plan altitude less than FL005.	Clear key	SP	A		
FPLN FULL	Attempt to insert more than 60 waypoints into the flight plan.	Clear key	SP	A		
GROUND ONLY	Attempt to perform a ground operation during flight.	Clear key	SP	A		
hold active	Hold is currently being executed.	Hold canceled.	A	N	X	
HOLD DEFINED	Attempt to attach a pattern on a waypoint with a Hold attached or an attempt to insert an offset when a holding fix is the TO waypoint.	Clear key	SP	A		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
HOLD IS ACTIVE	Attempt to delete the holding fix or modify the flight plan course or insert a PPOS hold or insert a waypoint at the active waypoint during hold execution.	Clear key	SP	A		
INSERT CIR BEFORE?	A circle pattern with a defined fix has been selected for insertion into the fpln or alternate flight plan.	Clear key or valid insert.	SP	N		
INSERT CRP BEFORE?	A closed random pattern with a defined fix has been selected for insertion into the fpln or alternate flight plan.	Clear key or valid insert.	SP	N		
INSERT FG8 BEFORE?	A figure 8 pattern with a defined fix has been selected for insertion into the fpln or alternate flight plan.	Clear key or valid insert.	SP	N		
INSERT INTR BEFORE?	An intercept has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INSERT PRESET AT?	A preset has been selected for insertion into the scan list.	Clear key or valid insert.	SP	N		
INSERT RTK BEFORE?	A racetrack pattern with a defined fix has been selected for insertion into the fpln or alternate flight plan.	Clear key or valid insert.	SP	N		
INSERT SID BEFORE?	A SID has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INSERT STAR BEFORE?	A STAR has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INSERT G-APR BEFORE?	A GPS data base approach has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INSRT T-APR BEFORE?	A Tactical approach has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INSRT V-APR BEFORE?	A Visual approach has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INTERCEPT DEFINED	Attempt to enter VNAV parameters for or attach a Hold or pattern to a point defined as an intercept.	Clear key	SP	A		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
intr active	An intercept is currently the flight plan TO waypoint.	Deletion of intercept point via Direct-To.	A	N	X	
INTR IS ACTIVE	Attempt to delete the intercept from the flight plan during execution (current TO) or attempt to modify the flight plan course when an intercept is the TO waypoint.	Clear key	SP	A		
INVALID DELETION	Attempt to delete the intercept or approach attributes, history waypoint (if only one exists), intercept, or MFP parameters when in the flight plan or alternate flight plan.	Clear key	SP	A		
INVALID ENTRY	Attempt to insert scratchpad data that does not pass format or range tests, attempt to select a function when insufficient data has been entered, or attempt to select a non-waypoint entry to call up the Data page.	Clear key or selecting a line key for which the entry is allowed.	SP	A		
INVALID SINCGARS	Attempting to perform a SINCGARS time operations when a SINCGARS error condition is present.	Clear key	SP	A		
key alert	GPS SA/AS keys will expire in 2 hours in the GPS receiver.	Clear key or entry of new keys passing time test.	A	B		
load fail	Failure passing data to/from the data cartridge.	Clear key or selecting another data loader load request.	A	N		
LOAD IN PROGRESS	Attempt to replace the active flight plan while the alternate flight plan is in the process of being loaded.	Clear key	SP	N		
locked	Password has been entered locking the system.	Entry of correct password or zeroizing the system.	A	N	X	
MAX INTRS IN FPLN	Attempt to insert more than 10 intercepts into flight plan.	Clear key	SP	A		
MAX PTRNS IN ALTN	Attempt to insert more than 20 patterns into the alternate flight plan.	Clear key	SP	A		
MAX PTRNS IN FPLN	Attempt to insert more than 20 patterns into the flight plan.	Clear key	SP	A		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
1000 FT MINIMUM	Attempt to enter VNAV or alternate flight plan altitude less than 1000 ft.	Clear key	SP	A		
need key	Insufficient GPS SA/AS keys in selected GPS for mission duration.	Clear key or entry of keys sufficient for mission duration or shortening mission duration to fit keys available.	A	B		
NET NOT FOUND	Attempt to tune to have a SINCGARS or HAVE QUICK net which is not stored in the CNMS preset list.	Clear key	SP	A		
no appr RAIM	Active when the following conditions are true: 1. When a transition to GPS approach mode occurs (2 nm from FAF) and the approach Predicative RAIM Availability is not available or unable to be computed. 2. AIM Available indicates unavailable when the MAP becomes the active waypoint. 3. RAIM Available indicates unavailable after the 5 minute **NO APPR RAIM** annunciation suppression period expires.	Data based GPS approach disabled or removed.	A	N		
No appr vnav	Insertion of a Minimum Descent Altitude (MDA) type approach into the flight plan.	Clear key or GPS approach removed from flight plan.	A	N		
NO CARTRIDGE	Attempt to access Data Loader Data when no cartridge is installed.	Clear key	SP	A		
no gps appr	Active when the following conditions are true: 1. Within 3 nm from the database FAF or the data based MAP is the TO. 2. Approach is enabled.	Navigation mode switched to a solution with valid GPS data or data base approach disabled or (MAP not the TO and FAF in history or deleted).	A	N		X

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
no gps appr (continued)	3. Navigation mode set to a non-GPS based solution.					
no keys zero	Failure to zeroize GPS SA/AS keys in all GPS receivers.	Clear key or subsequent successful clear of keys.	A	B		
NO MAG VAR	Attempt to enter Magnetic referenced input (Course, Bearing, or Track) without Magnetic Variation tables.	Clear key	SP	A		
no raim	RAIM is lost in selected GPS receiver and the **NO APPR RAIM** annunciation is not active or has been removed (30 second filter applies).	RAIM function is returned, or **NO APPR RAIM** annunciation is generated, or clear key.	A	N		
NON-SINCGARS MODE	Attempt to perform SINCGARS operations while not tuned to a SINCGARS mode.	Clear key	SP	A		
NOT Stored	Entry not found in database.	Clear key	SP	A		
ONLOAD DEFINED	Attempt to enter extra fuel or total fuel on the Fuel page when an on-load is defined in the alternate flight plan.	Clear key	SP	A		
PATTERN DEFINED	Attempt to attach a hold or pattern at a point defined to be a pattern, attempt to insert an offset when an MFP fix is the TO waypoint, or attempt to modify the pattern fix when the pattern has been inserted in the flight plan or alternate flight plan.	Clear key	SP	A		
PATTERN NOT IN FPLN	Attempt to enable refuel pattern when pattern is not in active flight plan.	Clear key	SP	N		
pca intercept	The intercept solution for the active waypoint is to the Point of Closest Approach.	Clear key or non-PCA intercept solution becomes available.	A	N		
RAIM CHECK ACTIVE	Attempt to enter RAIM prediction data when automatic approach RAIM point check is in progress.	Clear key or completion of point check.	SP	A		
RENUMBER FPLN	Attempt to insert a waypoint between non-inserted waypoint in the flight plan when the alphanumeric Z is already in use at the associated waypoint.	Clear key	SP	A		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
rfl active	Refuel pattern is currently being executed.	Refuel pattern canceled.	A	N	X	
RFL IS ACTIVE	Attempting to delete or modify the refuel fix or delete MFP attribute or modify the flight plan course or insert a PPOS hold or insert a waypoint at the active waypoint during pattern execution.	Clear key	SP	A		
RE-SELECT ARPT	Attempt the following immediately after data cartridge has been removed and reinserted or a data loader failure transient of more than 3 seconds occurs while the data cartridge is already inserted: 1. Select a SID or associated runway and no SID is currently in the working copy. 2. Select a STAR or associated runway and no STAR is currently in the working copy. 3. Select a database GPS approach from the FMS Approach page and no database GPS approach is currently in the working copy. 4. Select a visual approach from the FMS Approach page and no database GPS approach is currently in the working copy. 5. Select an IAF or insert a GPS approach and no database GPS approach is currently in the working copy. 6. Insert a visual approach and no visual approach is currently in the working copy.	CLR key or entry of four letter airport identifier on SID, STAR, or FMS Approach page.	SP	N		
rtk active	Racetrack pattern is currently being executed.	Racetrack pattern canceled.	A	N	X	

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
RTK IS ACTIVE	Attempting to delete or modify the racetrack fix or delete MFP attribute or modify the flight plan course or insert a PPOS hold or insert a waypoint at the active waypoint during pattern execution.	Clear key	SP	A		
safe keys	GPS SA/AS keys on the GPS's.	Clear key	A	N		
SELECT ALTN LOAD	Access the Alternate Flight Plan Catalog page from the Start 3 page.	Clear key or select alternate.	SP	N		
SELECT SID/RWY	Attempt to access SID Transitions page without both SID and RWY selected.	Clear key or selecting a SID or RWY.	SP	N		
SELECT STAR/RWY	Attempt to access STAR Transitions page without both STAR and RWY selected.	Clear key or selecting a STAR or RWY.	SP	N		
SET MASTER OFF	Attempt to set late net entry to ON when the ARC-210 has been designated net master.	Clear key	SP	A		
sincgars cue	V/UHF R/T indicates to the FMS that another user is on the cue frequency.	Clear key	A	B		
SINCGARS MODE	Attempting to send or receive time or toggle squelch while tuned to a SINCGARS channel.	Clear key	SP	A		
TIME OP IN PROCESS	Comm time operation being performed.	Clear key	SP	A		
UNUSED FUNCTION	Attempt to select IFF or M3 key.	Clear key	SP	N		
update magvr	Current magnetic variation data is more than 6 months old.	Clear key or load new magnetic variation data.	A			
USER WPT LIST FULL	Attempt to add a user waypoint when the user waypoint database is full.	Clear key	SP	A		

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
verify proc	In AUTO or FLYOVER sequencing mode when TTG is one minute before sequencing into a discontinuity or the TTG is less than 1 minute when the waypoint preceding a discontinuity becomes the TO waypoint.	Clear key or delete the discontinuity, delete the associated waypoint, insert a waypoint between the discontinuity and the associated waypoint, remove the related SID, STAR, or Approach or direct-to any waypoint or the discontinuity becomes the active waypoint.	A	N		X
VNAV IS ACTIVE	Attempt to toggle between **CLIMB** and **DESCNT** when a VNAV is active.	Clear key	SP	A		
V/UHF BUSY	Attempt to request a V/UHF sequence while another sequence is in progress for the same radio.	Clear key	SP	A		
WPT MAX EXCEEDED	Attempt to enter a SID or STAR with more than 30 waypoints.	Clear key	SP	N		
wpt passed	Active waypoint passed and sequencing to the next waypoint is inhibited.	Clear key, or sequence waypoint.	A	N		
wrong key	Incorrect SA/AS key received.	Clear key on entry of correct key.	A	B		
xtk alert	Aircraft cross track deviation exceeds crew entered specified threshold (with 3-second filter).	Clear key or aircraft is maneuvered to bring the cross track deviation within the threshold or the deviation threshold is expanded.	A	B		
XXXX:XX	UTC DISPLAY enabled on the Start 1 page.	Disable UTC DISPLAY on Start 1 page.	A	N	X	

Table 3B-9. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION /SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
LEGEND:	Location: SP scratchpad message A annunciation line					
	Blinking: N steady (non-blinking) B blinking A alternating (between SP message and entered SP data)					
	Not Clearable: X annunciation is non-clearable					
	MSG Alert: X activates external CDU alert annunciation					

Table 3B-10. CDU Annunciation Line Priorities

ANNUNCIATIONS	
ident	inux battery
m4 warn	wpt passed
m4 reply	pca intercept
locked	crs reversal
√version	√baroset
no appr vnav	approach
discontinuity	sincgars cue
verify proc	√speed
enter utc	√status
√timer 1	exiting hold
√timer 2	hold active
√timer 3	intr active
no gps appr	crp active
no appr raim	rfl active
no keys zero	fg8 active
safe keys	rtk active
xtk alert	cir active
√bank limit	key alert
√nav source	need key
√nav error	wrong key
√gps	load fail
compare gps	data expired
no RAIM	update magvr
√inux	XXXX:XX *

* XXXX:XX represents the UTC time (e.g., 0810:40)

In addition to the annunciations and scratchpad messages listed in Table 3B-9, the FMS-800 will provide the additional alerts listed in Table 3B-11 to inform the flight crew of various flight conditions. These alerts may appear either on electronic flight instrument displays or on annunciator light displays.

c. Power Control.

(1) FMS-800 System Power. All FMS-800 units operate from 28 Vdc aircraft essential bus power. Power is provided through a 5-ampere CB placarded **FMSI** on the right side circuit breaker panel.

(2) CDU Power Control of Associated Subsystems. Using the CDU, the crew can control the power on**/**off state of the avionic subsystems managed by the FMS-800. Whenever a unit is powered off, the CDU shows dashes for the data normally supplied by that unit. Attempts by the flight crew to control that subsystem is inhibited and results in a √POWER message in the scratchpad.

(3) CDU Power Control Procedures. On Index 1 page, pressing the **POWER** line select key displays the Master Power page. Refer to Figure 3B-20 and Table 3B-12. This page permits on**/**off control of individual communication or navigation radios. It also provides a **RADIO MASTER** selection which turns the controlled radio on or off.

Table 3B-11. Additional Alerts

TYPE OF ALERT	INITIATING CONDITION
Waypoint	Within waypoint alert prior to waypoint sequence when in EN ROUTE and OCEANIC sensitivity modes. Ten seconds prior to waypoint sequence when in TERMINAL and APPROACH sensitivity modes.
Terminal	FMS in Terminal Mode.
Approach	FMS in Transition or Approach Mode.
RAIM Alert	GPS RAIM function detects error (RAIM Warn).
Parallel Track	Parallel offset has been applied to the active flight plan.
CDU MSG Alert Light	The MSG Alert column in this table lists which annunciations are accompanied by a message alert.
No INPUT (with a blank screen)	A bus terminal has taken control of the MIL-STD-1553 bus, but is not responding as a bus controller. Activate the bus-split switch to split operations and isolate the faulty device on the 1553 bus. Or CDU has experienced a catastrophic failure of the CDU chip or a flash memory fault and should not be used for navigation because navigation data may be corrupted and extremely unreliable. Switch to backup navigation means immediately. **NOTE** **A power reset of the CDU may restore full operation if the failure was caused by the CDU's misreading its terminal address during cyclic power fluctuations. If this occurs, cross check all navigation data until you are ensured that the primary FMS-800 system is operating properly.**

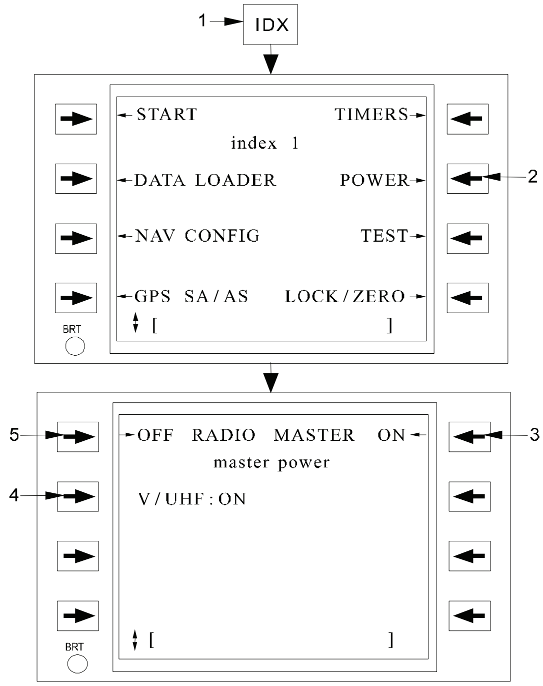


Figure 3B-18. Master Power Page

Table 3B-12. Master Power Page

NO.	DESCRIPTION/FUNCTION
1	Select index 1 page.
2	Access Master Power page.
3	To set all communication radio power to **ON**.
4	Toggle individual unit power **ON** or **OFF**.
5	To set all communication radio power to **OFF** (requires confirmation).

d. System Initialization.

(1) *Initialization Overview*. The FMS-800 system preflight initialization includes confirming or entering the current position, time, and date for GPS initial acquisition. It also verifies the cartridge effectivity date of the data loader cartridge and erasing or loading of flight plan and mission data.

(2) *Initialization Procedures*. A normal preflight start-up procedure is as follows:

1. Verify or enter position, time, date, and chart datum on the Start 1 page. Refer to Figure 3B-21 and Table 3B-13. Normally the GPS will provide the correct position, time, and date shortly after the GPS power is turned on.

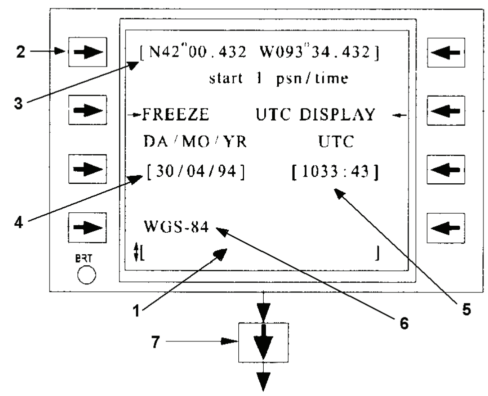


Figure 3B-19. Start 1 Position/Time Initialization

Table 3B-13. Start 1 Position/Time Initialization Procedures

NO.	DESCRIPTION/FUNCTION
1	Enter airport identifier in Scratchpad.
2	Press Left Line Key 1.
3	Verify the Lat and Long.
4	Verify UTC date, change as required.
5	Verify UTC time, change as required.
6	Verify current system datum.
7	Scroll to Start page 2.

2. Press Left Line Key 1, then scroll to Start page 3. Refer to Figure 3B-22 and Table 3B-14.

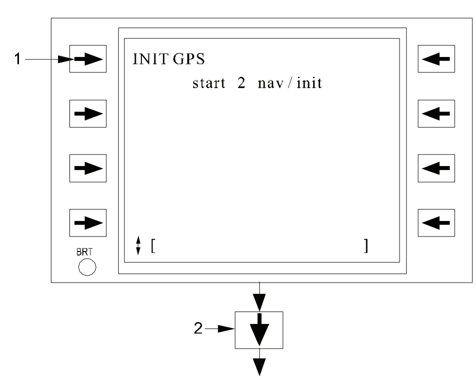


Figure 3B-20. Start 2 Navigation/Initialization

Table 3B-14. Start 2 Navigation/Initialization Procedures

NO.	DESCRIPTION/FUNCTION
1	Press Left Line Key 1/Command initialization.
2	Press Scroll Key/Scroll to Start page 3.

3. Scroll to the Start 3 page and verify the effectivity date of the ICAO database is correct. Refer to Figure 3B-23 and Table 3B-15. If a new flight plan and mission data are to be entered manually, select **ERASE FPLN**. If a new plan is to be loaded from the cartridge, first enter the desired flight plan number or access the Alternate Flight Plan Catalog and select the desired flight plan (requires confirmation – select twice). After loading is complete, select **FPLN REPLACE**. This transfers the alternate flight plan data into the active flight plan so that both plans are identical at the beginning of the mission. The crew may select **FLT /DATA LOAD** to load all remaining preplanned mission data, including the radio presets, V/UHF Have Quick II MWOD's, FMT's, SINCGARS net identifiers, and user waypoint and markpoint lists.

4. Access the Navigation/ Communication Radio Information pages to view the desired presets and channels for each radio.

5. Access the Status pages for all LRU's and confirm the current status conditions, including bus status, indicate **GO** for all LRU's.

6. To prepare the FMS for recording the fault history of the flight, access the data Loader pages and select the **STAT SAVE** line select key twice. This resets the date and time stamped to the current day and time and initializes the fault history record.

7. Configure the system for desired behavior and performance.

NOTE

Position, time, and date are periodically updated with GPS data when it is valid.

The Start 1 Page is initially displayed following FMS startup.

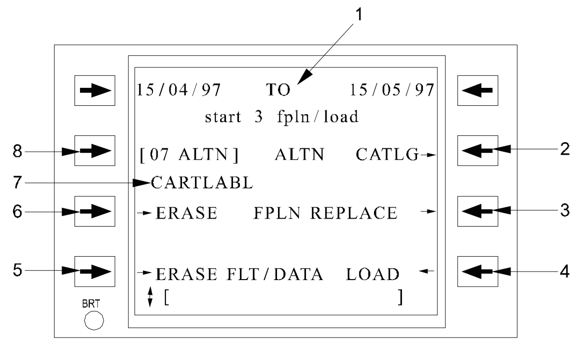


Figure 3B-21. Start 3 Flight Plan/Load Page

Table 3B-15. Start 3 Flight Plan/Load Procedures

NO.	DESCRIPTION/FUNCTION
1	Effectivity dates for ICAO identifier database.
2	Select for catalog of available alternate flight plans.
3	Replace the active flight plan with the alternate flight plan.
4	Load mission data from data cartridge.
5	Erase mission data.
6	Erase flight plan.
7	User defined data cartridge label (defined at ground station).
8	Enter desired alternate flight plan number or name.

(3) Navigational Chart Datums. The normal global chart datum is WGS-84. The current system datum is indicated on the Start 1 page.

(4) Initializing Configuration Functions.

(a) Time Annunciation. On the Start 1 page, select the UTC DISPLAY line select to enable a continuous display of actual UTC time on the annunciation line. Time will be continuously displayed on the annunciation line when enabled. When higher priority annunciations "hide" the time, press **CLR** to

acknowledge the annunciation and restore time as the foremost annunciation.

(b) Freeze Position. When FREEZE is selected on the Start 1 page, the position on the first line of the page will be frozen. Typically, the GPS position as displayed on this page will continuously change as the GPS solution updates, even when stationary on the ground. When frozen, the position can be copied to other pages as desired or used to begin initialization of the GPS receiver.

When a position is entered manually at line 1, left or right, the position is automatically frozen for use. To unfreeze, select the freeze line and select again.

The position frozen on the first line is used by the system as waypoint 00 when loading a flight plan for active use and as the starting position of the model aircraft function. If waypoint 00 is not at the desired starting position when initializing the system, enter the desired position on the Start 1 page and either load a new flight plan from the alternate flight plan or erase the flight plan, see the following paragraph. The start position will then be inserted as waypoint 00 in the flight plan.

(c) Erasing System Data. On the Start 3 page, two selections are available to erase the active flight plan and the user waypoint and markpoint lists. The erase function requires confirmation by the operator, and when confirmed will erase data from the CDU's memory. Erasure does not affect the flight plans, user waypoint and markpoint lists, or radio presets on the data cartridge.

(d) FMS Guidance Configuration. On the Navigation Configuration 1 page, the current mode of flight can be inspected by the pilot or overridden at pilot request. Refer to Figure 3B-24 and Table 3B-16. Under normal operation, the FMS will automatically configure the FMS for the current mode of flight, selecting either **TERMINAL**, **EN ROUTE**, or **APPROACH**. If a different flight mode is desired, including OCEANIC, select the **FLT MODE** line select to activate the desired mode. The flight mode not only affects the scaling of deviation pointers, but also sets the limits of the GPS RAIM function and navigation accuracy limits. The system bank limit can be entered on the Navigation Configuration 1 page. The bank limit applies to FMS guidance during execution of the flight plan.

(e) External Alert Configuration. On the Navigation Configuration 2 page, alert thresholds can be entered to configure the FMS alerts to desired limits that the pilot wishes to maintain. When the FMS reaches the alert threshold, an appropriate annunciation or external alert is provided to advise the pilot. When crosstrack deviation is exceeded, an XTK ALERT annunciation is provided until the aircraft is maneuvered back into desired limits. When the speed of the aircraft exceeds the speed alert limits, a √SPEED annunciation is provided until the aircraft's speed is throttled back within limits.

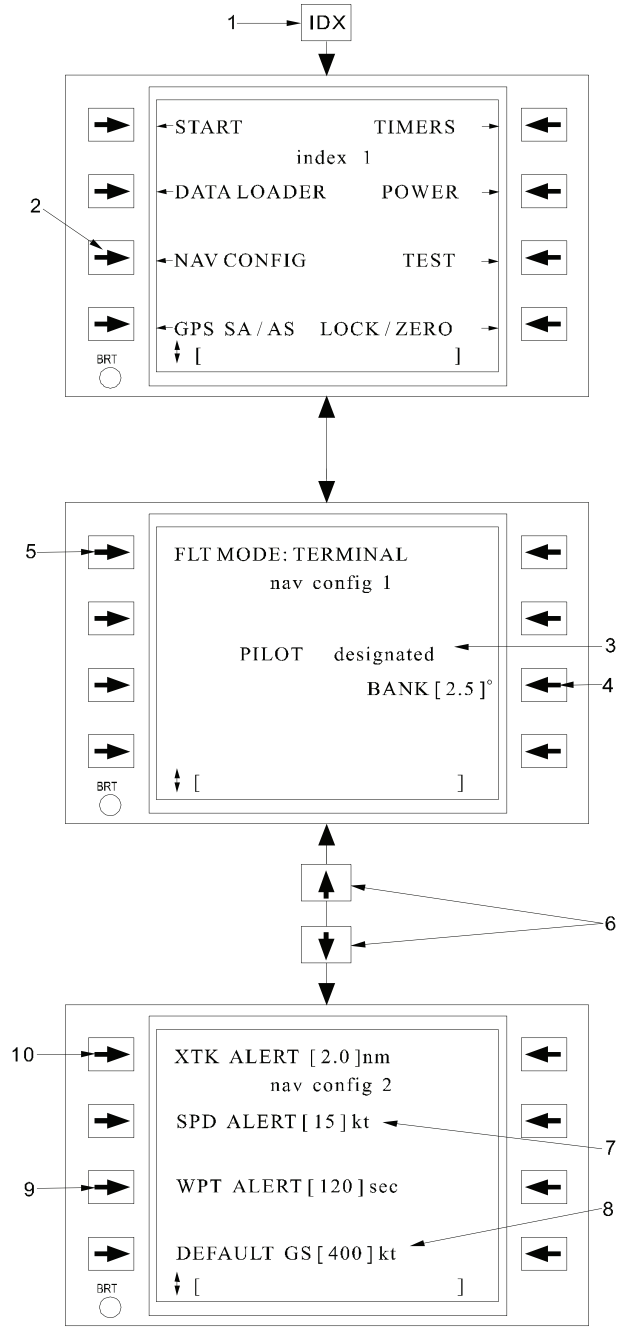


Figure 3B-22. Navigation Configuration Page Access and Functions

Table 3B-16. Navigation Configuration Page Access and Functions

NO.	DESCRIPTION/FUNCTION
1	Select Index 1 page.
2	Access Nav Config 1 page.
3	Indication of designated pilot selection.
4	Flight Plan Guidance-Blank Limit.
5	Flight instrument scaling mode selection: OCEANIC, EN ROUTE, TERMINAL, or APPROACH.
6	Scroll vertically to access more configuration pages.
7	Entered Speed deviation alert threshold (knots).
8	Entered ground speed default for calculations while on the ground.
9	Entered waypoint alert time in seconds prior to waypoint arrival or leg switch.
10	Entered cross track deviation alert threshold (nautical miles).

When a waypoint alert time is entered, the FMS will provide an external waypoint alert advisory and then the FMS will sequence to the next waypoint with the alert threshold. This waypoint alert threshold only affects external advisories on capsule lights or flight instruments to give the pilot a heads-up of impending transitions while in OCEANIC or EN ROUTE flight modes. When in TERMINAL or APPROACH modes, the FMS and external advisories will always be generated 10 seconds prior to waypoint sequencing.

(f) Ground Calculation. When on the ground, the FMS provides the pilot the ability to review flight profiles and system calculations. On the Navigation Configuration 2 page while on the ground, a groundspeed entry is provided for the pilot to forecast anticipated performance in flight and provide expected flight times enroute to each destination in the flight plan.

e. Active Flight Plan Waypoints and Courses.

(1) Flight Plan Overview. The active flight plan is a list of up to 60 waypoints, stored in the order they are to be flown. The flight plan is maintained through addition, modification, or deletion of waypoints. When a waypoint is passed, it is retained in the flight plan history list, where the last 39 passed waypoints are maintained in order. History waypoints are identified in the flight plan with a **#** symbol following the waypoint number and may be viewed by scrolling the Flight Plan page using the ↑ key. The crew may delete history waypoints, using a **–** entry, but may not enter waypoints into history.

The FMS-800 guidance function assists in execution of the flight plan by determining deviations from the desired flight plan and controlling the sequencing of waypoints. When automatic leg advance is selected via the Flight Plan page, waypoint switching is determined as a function of aircraft speed, wind, and magnitude of course change to provide turn anticipation. A waypoint alert is generated prior to reaching the waypoint switching point for the next leg.

(a) Flight Plan Loading. There are three ways to enter flight plan data:

1. Through the active flight plan.

2. The alternate flight plan.

3. The data cartridge catalog.

(b) Data Cartridge. The data cartridge is a storage device containing a catalog of Alternate Flight Plans (AFP). The cartridge can be modified at a Mission Planning Ground Station (MPGS) which can store thousands of unique flight plans. Up to 40 of those flight plans at one time can be transferred from the MPGS to the Alternate Flight Plan Catalog in the data cartridge. The pilot can then choose one of these AFP's from the catalog on the data cartridge to load into the AFP in the CDU. After loading the AFP, the pilot can make any changes or transfer the AFP directly to the active flight plan. If desired, the pilot can also modify an AFP and save it back to the catalog in the cartridge. Refer to Figure 3B-25 for a summary of the information flow.

(2) Flight Plan Active Waypoint. The waypoint that all flight instrument and CDU guidance displays are referenced, is referred to as the active waypoint. Pressing the **FPLN** key on the CDU accesses the Flight Plan page with the active waypoint displayed as the TO waypoint. This is signified by ↓↓ pointing to the active waypoint.

Associated with the active waypoint are the following parameters, which are displayed on the Flight Plan page.

1. Current desired inbound course measured at the waypoint, not current desired track at aircraft position.

2. Source of inbound course. The three sources are: Computed (↓ ↓), manually entered (↓ man ↓), or direct-to (↓ dir ↓).

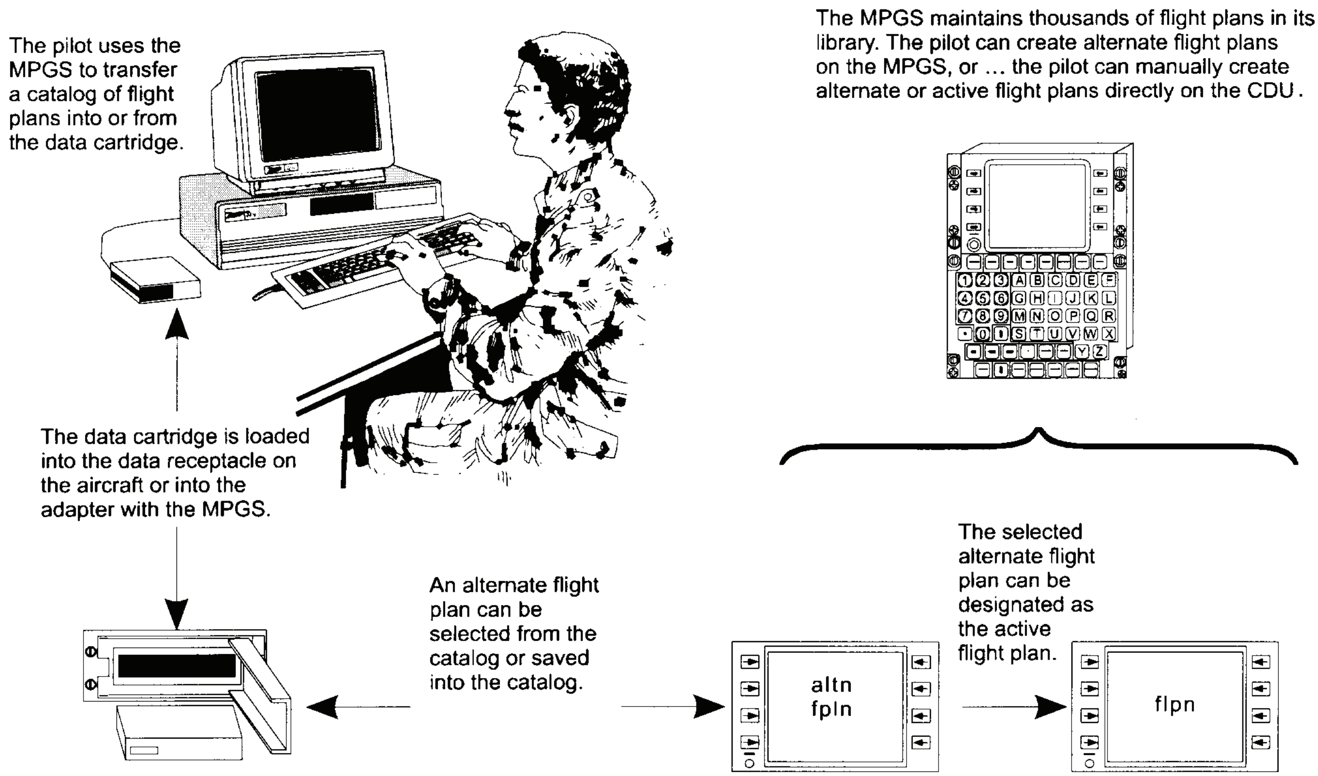


Figure 3B-23. Flight Plan Management

3. Waypoint number in flight plan sequence.

4. Flight Plan sequencing mode.

5. Waypoint attribute (hold etc.).

6. FROM indication on right side of title indicating when on the From side of the active waypoint.

7. Outbound course and distance to the next waypoint after the active waypoint.

The Flight Plan page as it appears when initially accessed. Refer to Figure 3B-26 and Table 3B-17.

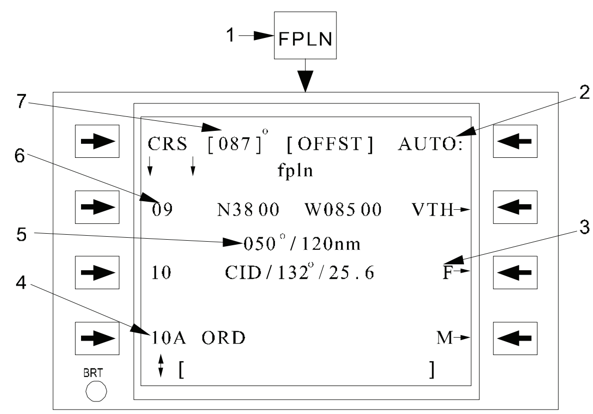


Figure 3B-24. Flight Plan Active Waypoint

Table 3B-17. Flight Plan Active Waypoint

NO.	DESCRIPTION/FUNCTION
1	Select FPLN.
2	Sequencing mode toggles between AUTO, FLYOVER, and MAN sequencing modes.
3	Waypoint attached attribute.
4	Waypoint sequence number.

Table 3B-17. Flight Plan Active Waypoint (Continued)

NO.	DESCRIPTION/FUNCTION
5	Outbound course and distance to next waypoint.
6	Active waypoint
7	Course at active waypoint.

When a waypoint becomes a history waypoint, a **#** following the waypoint number indicates that the waypoint is no longer an active or future waypoint.

(3) Flight Plan Waypoints.

(a) Numbering of Waypoints. A maximum of 60 active waypoints and 39 history waypoints are allowed in the flight plan at a time. The flight plan waypoints are numbered sequentially in increments of one, from 01 to 99, with waypoint 00 as the initial history waypoint. If a waypoint is added past 99, the numbering starts at 01 and uses the first available waypoint number not used by a history or active waypoint. Non-SID, STAR, approach, or alternate flight plan waypoints that are inserted between existing waypoints receive an alphabetical suffix. If a SID, STAR, approach, or alternate flight plan is inserted into the flight plan, no alphabetical suffix is used. The SID, STAR, and approach waypoints are numbered in the normal method with subsequent waypoints automatically renumbered. These features prevent the duplication of a waypoint number within the flight plan.

(b) Inserting Waypoints in Sequence. When the flight plan has been erased, the Start 1 page starting position is inserted as the first history waypoint and the Flight Plan page indicates *END in lieu of the active waypoint. Refer to Figure 3B-27 and Table 3B-18.

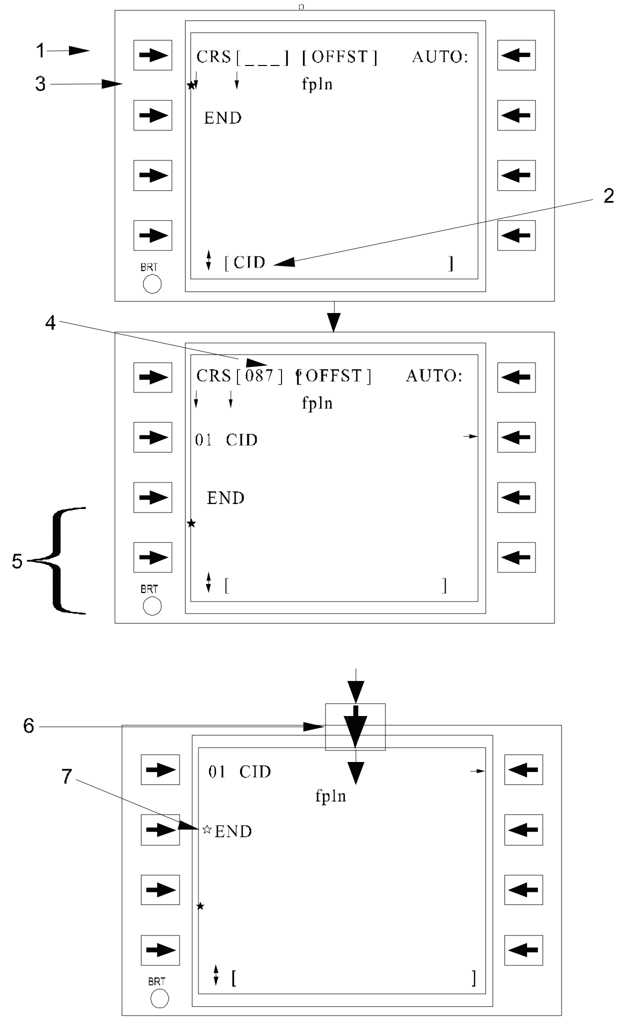


Figure 3B-25. Inserting Flight Plan Waypoints in Sequence

Table 3B-18. Inserting Flight Plan Waypoints in Sequence

NO.	DESCRIPTION/FUNCTION
1	Erase Flight Plan as described.
2	Enter first desired waypoint into the scratchpad.
3	Insert waypoint.
4	Horizontal course into the first waypoint is computed and displayed.
5	Succeeding waypoints may be inserted in sequence, numbers are automatically assigned.
6	Scroll to insert additional waypoints, if more than three.
7	Indicates end of flight plan marker.

When a waypoint is inserted before *END, when *END is on the last line, the Flight Plan page automatically scrolls as necessary to keep the *END indicator in view on the bottom line. This permits the pilot to enter a long sequence of points without having to manually scroll the page. The FPLN FULL message will appear in the scratchpad if there is an attempt to load a 61st waypoint.

(c) Inserting and Deleting Intermediate Waypoints. In most cases the waypoints may be inserted or deleted between any two waypoints in the flight plan. When waypoints are inserted, succeeding waypoints are automatically moved down the list. Upon insertion, the new waypoints assume the number of the immediately preceding waypoint and adds an alphabetical suffix (e.g. 03A, 03B, etc). Exception to this would be when a waypoint is inserted between waypoints that already have an alphabetical suffix, the next character in sequence would be used as the next suffix. If lettering goes as high as Z and there is an attempt to insert another waypoint, the RENUMBER FPLN scratchpad message will occur. When the waypoints are deleted, the flight plan automatically eliminates all holes by moving waypoints up the list as required. The waypoint numbers being out of the normal sequence can identify deleted waypoints.

There are three exceptions to the above waypoint statements as follows. Refer to Figure 3B-28 and Table 3B-19.

1. Inserting a new FROM waypoint: Instead of waypoints moving down the list when inserting a new FROM waypoint, the current FROM waypoint moves up the list. An alphabetical suffix is added based on the preceding waypoint, which was the former FROM waypoint.

2. No waypoints can be inserted between any two-history waypoints.

3. The last history waypoint (waypoint 00) cannot be deleted.

Sixty waypoints is the maximum number of waypoints allowed in the active flight plan. The FPLN FULL message will appear in the scratchpad if an insertion of a 61st waypoint is attempted.

(d) Renumbering Flight Plan Waypoints. After inserting or deleting waypoints, there becomes a requirement to renumber the flight plan to remove waypoints with alphabetical suffixes, perform the following procedures. First access the Flight Plan Edit 2 page and then select the **RENUMBER** line select key (requires confirmation). This causes all future flight plan waypoints to be renumbered in sequence without alphabetic suffixes, starting at the active waypoint number. The active waypoint and the history waypoints are not renumbered.

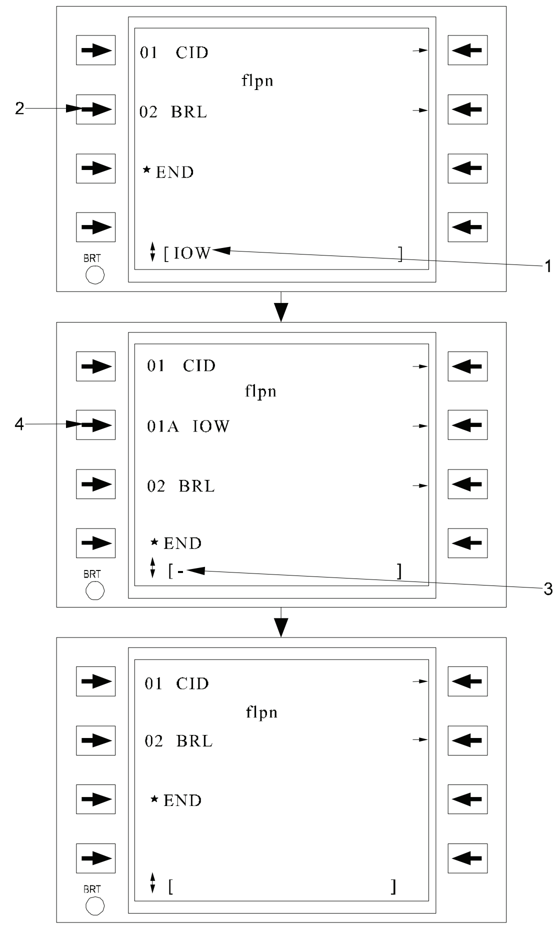


Figure 3B-26. Inserting and Deleting Intermediate Flight Plan Waypoints

Table 3B-19. Inserting and Deleting Intermediate Flight Plan Waypoints

NO.	DESCRIPTION/FUNCTION
1	Enter next desired waypoint into the scratchpad.
2	Insert waypoint, moving BRL down in the flight.
3	Enter a **–** in scratchpad to delete waypoint.
4	Delete waypoint, closing up the hole created in the flight plan.

(e) Modifying Waypoint Locations. If a bearing/distance (e.g., 050/23) is inserted at a waypoint identifier, that waypoint is offset by the bearing and distance, and displayed in the scratchpad with the bearing and distance offset applied. Refer to Figure 3B-29 and Table 3B-20. If the bearing and distance is applied at any other type of waypoint (e.g. latitude/longitude), the FMS-800 computes the offset latitude and longitude of the position and displays it in the scratchpad. Refer to Figure 3B-30 and Table 3B-21. In either of the two case stated above, the new waypoint can now be inserted into the fight plan. If the original waypoint needs to be deleted, follow the procedure in Paragraph 3B-19e(3)c.

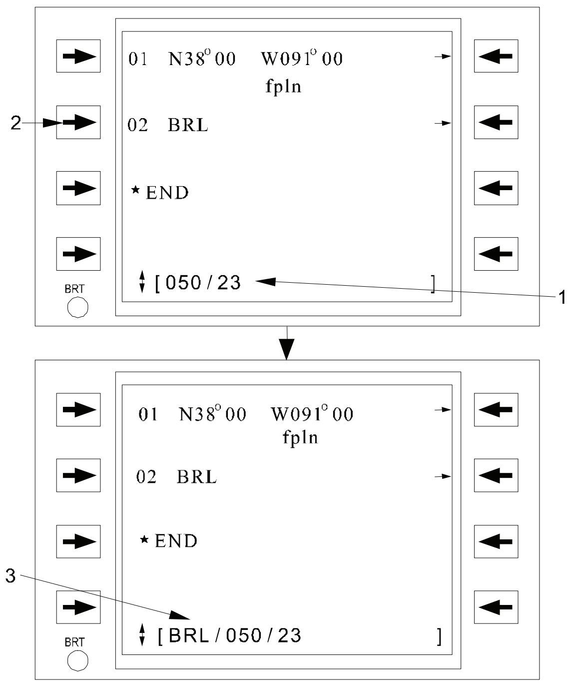


Figure 3B-27. Modifying Waypoint Identifier Locations

Table 3B-20. Modifying Waypoint Identifier Locations

NO.	DESCRIPTION/FUNCTION
1	Enter the bearing/distance offset into the scratchpad.
2	Apply the offset to BRL.
3	Ensure there is a new waypoint offset to the desired bearing/distance displayed in the scratchpad. It may be inserted into the flight plan as desired.

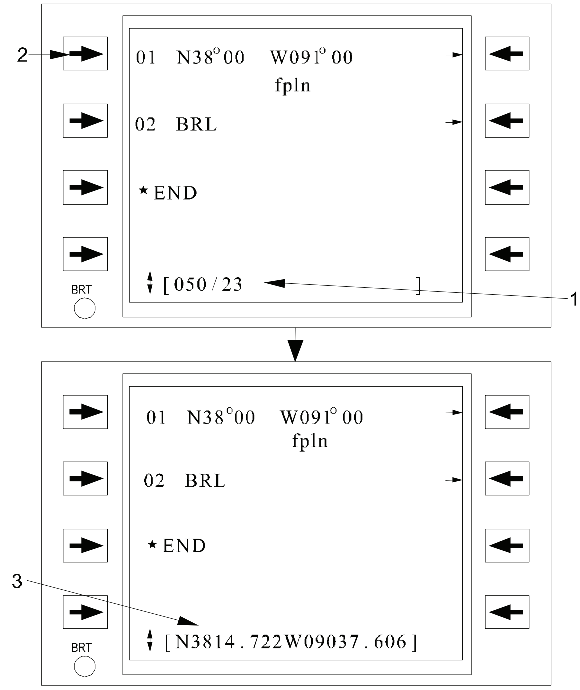


Figure 3B-28. Modifying Latitude / Longitude Locations

Table 3B-21. Modifying Latitude / Longitude Locations

NO.	DESCRIPTION/FUNCTION
1	Enter the bearing/distance offset in the scratchpad.
2	Apply the offset to a lat-long.
3	The computed lat-long is displayed in the scratchpad and available for insertion into the flight plan (original waypoint may be deleted manually if desired).

The bearing is referenced to the Station declination, for a waypoint that is a VOR, VORTAC, VOR-DME, or TACAN, and for all other waypoints.

(f) Waypoints with Duplicate Identifiers. If a waypoint identifier is entered which is duplicated in another area of the world, the Select Waypoint page is automatically accessed and displays the data for up to 20 waypoints having that identifier. Refer to Figure 3B-31 and Table 3B-22. If more than two do exist, the pages can be scrolled for viewing. Up to 19 duplicate identifiers will be searched from the primary ICAO database on the cartridge. One duplicate identifier will be searched from the User Waypoint list. The identifiers are ordered from closest to present position to furthest from present position when the navigation solution is valid. Select the desired waypoint by

pressing its adjacent line key and the CDU will immediately return to the original page with the waypoint inserted in the desired location. A frequency or station channel will only be displayed if the waypoint identifier is associated with a navigation radio beacon. Possible types of waypoints include VOR, V/T (for VORTAC), TCN (for TACAN), V/D (VOR-DME), NDB, N/D (for NDB-DME), FIX, APT (for Airport), and DME.

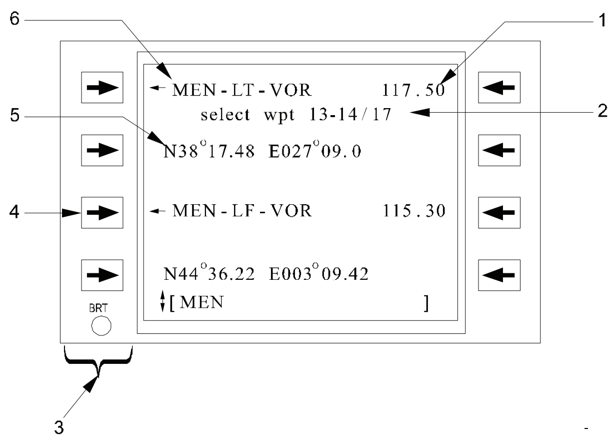


Figure 3B-29. Waypoints With Duplicate Identifiers

Table 3B-22. Waypoints With Duplicate Identifiers

NO.	DESCRIPTION/FUNCTION
1	NAV aid Frequency or channel (if an NDB, VOR, DME, or TACAN).
2	Signifies that the displayed waypoints are numbers 13-14 of a total of 17.
3	Line Select Keys 1 and 3 enter the adjacent waypoint into the originating page.
4	Selects the waypoint and enters it on the originating page.
5	Waypoint's latitude and longitude.
6	Waypoint ID, Country code and type.

The title line displays the number range of the displayed duplicate identifiers (i.e., 1-2, 3-4, 5-6, etc.) and the total number of duplicate identifiers for the entered waypoint. The scratchpad retains the original waypoint identifier entry until a duplicate waypoint identifier has been selected.

The information line will display SEARCH IN PROGRESS when a search for duplicates is being conducted. If a search is interrupted, SEARCH FAILED will be displayed. An interruption of a search can be caused by removal of the cartridge, a data receptacle failure, or bus controller swap.

A listing of the country codes is provided in Table 3B-23. This list is not meant to be comprehensive or current, because the country identifiers change frequently. Refer to ICAO Document No. 7910, Location Indicators, for a current listing. The country code ** is used for used defined waypoints.

(g) Flight Plan Waypoint Attribute Indicators. The right side of the FPLN page shows any special attributes that have been assigned to waypoints in the flight plan. These provide a quick reference for the pilot and are also indicated on the individual FPLN WPT pages where selection of the adjacent line key provides instant access to the respective pattern or other defined function. These attributes may be deleted by entering a **–** in the scratchpad and selecting the line key next to the attribute to be deleted. This feature enables the crew to delete maneuvers without leaving the FPLN page. If more than one attribute is displayed, the right-most attribute will be deleted first (e.g., if VH is displayed, the H will be deleted first). Table 3B-24 lists the attribute designators and their meanings.

Table 3B-23. Country Codes

A1	ANTARCTICA
AB	AUSTRALIA
AD	AUSTRALIA
AG	SOLOMON ISLANDS
AM	AUSTRALIA
AN	NAURU
AP	AUSTRALIA
AS	AUSTRALIA
AY	PAPUA NEW GUINEA
BG	GREENLAND
BI	ICELAND
CF	CANADA
CU	CANADA
CW	CANADA
CY	CANADA
CZ	CANADA
DA	ALGERIA
DB	BENIN
DF	BURKINA FASO
DG	GHANA
DI	IVORY COAST
DN	NIGERIA
DR	NIGER

Table 3B-23. Country Codes (Continued)

DT	TUNISIA
DX	TOGO
EB	BELGIUM
ED	GERMAN (W.)
EE	ESTONIA
EF	FINLAND
EG	UNITED KINGDOM
EH	NETHERLANDS
EI	IRELAND
EK	DENMARK
EL	LUXEMBOURG
EN	NORWAY
EP	POLAND
ES	SWEDEN
ET	GERMANY (E.)
EV	LATVIA
EY	LITHUANIA
FA	SOUTH AFRICA
FB	BOTSWANA
FC	CONGO
FD	SWAZILAND
FE	CENTRAL AFRICAN REPUBLIC
FG	EQUATORIAL GUINEA
FH	ASCENSION IS.
FI	MAURITIUS
FJ	BRIT INDIAN OCEAN TERR.
FK	CAMEROON
FL	ZAMBIA
FM	MADAGASCAR, COMORES, LA REUNION, MAYOTTE
FN	ANGOLA
FO	GABON
FP	SAO TOME AND PRINCIPE
FQ	MOZAMBIQUE
FS	SEYCHELLES
FT	CHAD
FV	ZIMBABWE
FW	MALAWI
FX	LESOTHO
FY	NAMIBIA
FZ	ZAIRE
GA	MALI
GB	FAMBIA
GC	CANARY ISLANDS
GE	MELIA
GF	SIERRA LEONE

GG	GUINEA BISSAU
GL	LIBERIA
GM	MOROCCO
GO	SENEGAL
GQ	MAURITANIA
GS	SAHARA OCCIDENTAL
GU	REP. De GUINEE
GV	CAPE VERDE
HA	ETHIOPIA
HB	BURUNDI
HC	SOMALIA
HE	EGYPT
HF	DJIBOUTI
HH	ERITREA
HK	KENYA
HL	LIBYA
HR	RWANDA
HS	SUDAN
HT	TANZANIA
HU	UGANDA
K*	USA
LA	ALBANIA
LB	BULGARIA
LC	CYPRUS
LD	CROATIA
LE	SPAIN
LF	FRANCE
LG	GREECE
LH	HUNGRY
LI	ITALY
LJ	SLOVENIA
LK	DZECH
LL	ISRAEL
LM	MALTA
LN	MONACO
LO	AUSTRIA
LP	PORTUGAL
LQ	BOSNIA AND HERZEGOVINA
LR	ROMANIA
LS	SWITZERLAND
LT	TURKEY
LU	REPUBLIC OF MOLDOVA
LW	MACEDONIA
LX	GIBRALTAR
LY	YUGOSLAVIA
LZ	SLOVAKIA

MB	TURKS AND CAICOS ISLANDS
MD	DOMINICAN REP
MG	GUATEMALA
MH	HONDURAS
MK	JAMAICA
MM	MEXICO
MN	NICARAGUA
MP	PANAMA
MR	COSTA RICA
MS	EL SALVADOR
MT	HAITI
MU	CUBA
MW	CAYMAN ISLANDS
MY	BAHAMAS
MZ	BELIZE
NC	COOK ISLANDS
NF	FIJI, TONGA
NG	KIRIBATI, TUVALU
NI	NIUE ISLAND
NL	WALLIS ISLAND
NS	SAMOA
NT	FRENCH POLYNESIA
NV	VANUATU
NW	NEW CALEDONIA
NZ	NEW ZEALAND
OA	AFGANISTAN
OB	BAHRAIN
OE	SAUDI ARABIA
OI	IRAN
OJ	JORDAN
OK	KUWAIT
OL	LEBANON
OM	UNITED ARAB EMIRATES
OO	OMAN
OP	PAKISTAN
OQ	BOSNIA AND HERZEGOVINA
OR	IRAQ
OS	SYRIA
OT	QATAR
OY	YEMEN
PA	ALASKA
PB	BAKER ISLAND
PC	PHOENIX ISLAND
PF	ALASKA
PG	MARIANA ISLAND OR GUAM
PH	HAWAII

Table 3B-23. Country Codes (Continued)

PJ	JOHNSTON ISLAND
PK	MARSHALL ISLANDS
PL	LINE ISLAND OR KIRIBATI
PM	MIDWAY ISLAND
PO	ALASKA
PP	ALASKA
PT	MICRONESIA
PW	WAKE ISLAND
RC	CHINA (TAIWAN)
RJ	JAPAN
RK	KOREA
RP	PHILIPPINES
S1	ANTARCTICA
SA	ARGENTINA
SB	BRAZIL
SC	CHILE
SE	ECUADOR
SF	FALKLAND ISLANDS
SG	PARAGUAY
SK	COLOMBIA
SL	BOLIVIA
SM	SURINAM
SN	BRAZIL
SO	URUGUAY
SV	VENEZUELA
SY	GUYANA
TA	ANTIGUA, BARBUDA
TB	BARBADOS
TD	DOMINICA
TF	FRENCH ANTILLES
TG	GRENADA
TI	VIRGIN IS (U.S.)
TJ	PUERTO RICO
TK	ST. KITTS-NEVIS
TL	ST. LUCIA
TN	NETHERLANDS ANTILLES, ARUBA
TQ	ANGUILLA ISLAND
TR	MONTSERRAT IS
TT	TRINIDAD AND TOBAGO
TU	VIRGIN IS (U.K.)
TV	ST. VINCENT, GRENADINES
TX	BERMUDA
U*	RUSSIA
UA	KAZAKHSTAN, KYRGYZSTAN
UB	AZERBAIJAN
UE	RUSSIA
UG	GEORGIA
UH	RUSSIA
UI	RUSSIA
UK	MOLDOVA, UKRAINE
UL	RUSSIA
UM	RUSSIA, BELARUS
UN	RUSSIA
UO	RUSSIA
UR	RUSSIA, KAZAKHSTAN
US	RUSSIA
UT	KAZAKHSTAN, TAJIKISTAN, TURKEMISTAN, UZBEKISTAN
UU	RUSSIA
UW	RUSSIA
VA	INDIA
VB	BYANMAR
VC	SRI LANKA
VD	CAMBODIA
VE	INDIA
VG	BANGLADESH
VH	HONG KONG
VI	INDIA
VL	LAOS
VM	MACAO
VN	NEPAL
VO	INDIA
VQ	BHUTAN
VR	MALDIVES
VT	THAILAND
VV	VIETNAM
VY	MYANMAR
WA	INDONESIA
WB	MALAYSIA, BRUNEI
WI	INDONESIA
WM	MALAYSIA
WP	INDONESIA
WR	INDONESIA
WS	SINGAPORE
Y*	AUSTRALIA
YB	AUSTRALIA
YM	AUSTRALIA
YP	AUSTRALIA
YS	AUSTRALIA
ZB	CHINA
ZG	CHINA
ZH	CHINA
ZK	KOREA
ZL	CHINA
ZM	MONGOLIA
ZP	CHINA
ZS	CHINA
ZT	CHINA
ZU	CHINA
ZW	CHINA
ZY	CHINA

Table 3B-24. Attribute Designators

ATTRIBUTE	DESCRIPTION
C	A course reversal is enabled at this waypoint.
D	A DME Arc will be flown to this waypoint. DME Arcs only exist in published GPS approaches.
F	The waypoint is designated as the Final Approach Fix (FAF) for database and tactical approaches.

Table 3B-24. Attribute Designators (Continued)

ATTRIBUTE	DESCRIPTION
H	A holding pattern has been attached to this waypoint. If the waypoint is an IAF or Missed Approach Holding Point with a database Holding Pattern attached, this attribute is displayed on the holding Flight Plan page when the holding pattern is enabled.
I	The waypoint is a valid intercept solution for a moving target.
M	The waypoint is designated as the Missed Approach Point (MAP).
P	This waypoint is a fix for a pattern that will be executed upon arrival at the point.
R	This waypoint is part of a STAR.
S	This waypoint is part of a SID.
T	The waypoint has a desired time of arrival associated with it. This indicates that a Time Navigation (TNAV) function will be performed to obtain the Required Time of Arrival (RTA) on the Flight Plan Waypoint page.
V	The waypoint has an altitude specified that will cause vertical navigation to be performed.

Up to three attributes can be assigned to each waypoint. Attribute hierarchy and possible attribute combinations are shown in Table 3B-25. Attributes within each column of the table can not be assigned to the same waypoint.

Table 3B-25. Attribute Hierarchy

ATTRIBUTES			
M	T	V	H
D			C
F			P
I			
R			
S			

NOTE

The right-most column of attributes shown in this table is deleted first when used in combination with other listed attributes.

(4) Automatic Leg Advance. When waypoints beyond the active waypoint are in the flight plan and the flight plan advance mode is automatic (AUTO or FLYOVER mode), the FMS-800 computes great circle tracks between those waypoints. It will also, automatically transition smoothly from one waypoint to the next.

To sequence past a waypoint, the aircraft track angle must be within 90° of the active leg course; the Track Angle Error (TKE) must be within 90°. Otherwise, sequencing will be inhibited and guidance will continue to reference the inbound course to the waypoint.

To prevent overshoot of the next leg, automatic leg switching in AUTO mode includes turn anticipation, up to 30 nm prior to the waypoint, for course changes ≤ 150°. Over 150°, the waypoint will be overflown and a teardrop turn is made to intercept the next leg. Refer to Figure 3B-32.

NOTE

When the change in the resulting course between flight plan legs is greater than 150°, the FMS will provide guidance to turn and intercept the next course, resulting in an S-turn maneuver into the course. The course to the next waypoint is based on geometry between waypoints, not waypoint course guidance, for smooth turns.

When the pilot has selected the FLYOVER mode, leg switching is also automatic, but each waypoint is overflown prior to turning to intercept the next leg.

Prior to the leg switch point, the waypoint alert light illuminates and the waypoint number on the Flight Plan page and the ↓ to ↓ indicator on the Lateral Steer page will flash for 10 seconds.

When the MAP becomes the active waypoint, sequencing is automatically inhibited as the sequence mode is switched to MAN. On the TO side of the MAP, pilot selection of AUTO sequencing is inhibited; AUTO can be selected on the FROM side of the MAP. A Direct-To any waypoint other than the MAP will switch sequencing back to AUTO.

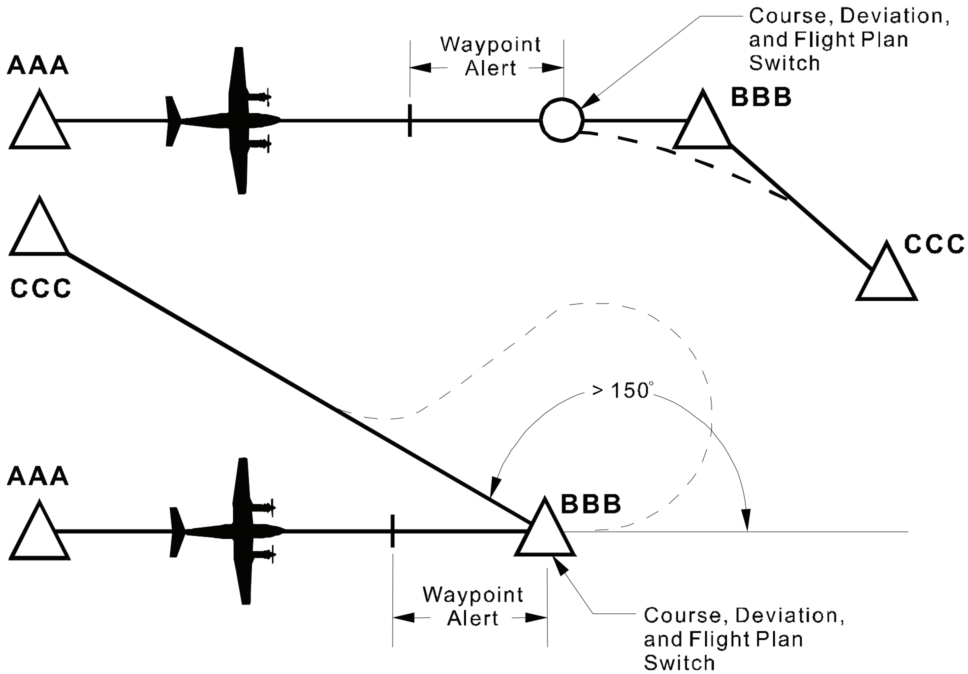


Figure 3B-30. Lateral To-To Course Transitions with Automatic Sequencing

The FMS will automatically revert from FLYOVER to AUTO sequencing for procedure execution when the first SID, STAR, or APPROACH waypoint becomes the active waypoint or the aircraft enters the TERMINAL area. If a SID, STAR, or APPROACH point is specifically identified as a flyover waypoint in the database procedure, the FMS will sequence the waypoint in flyover mode but remain in AUTO sequence mode on the Flight Plan page. The pilot may override the automatic sequence mode selections, except when the MAP is the active waypoint.

(5) Manual Sequencing and Course Selection.

(a) Manual Sequence Mode. When manual sequencing is selected, the flight plan does not advance to the next leg automatically. The flight plan only sequences when the crew performs one of the following three actions: selects AUTO; selects FLYOVER sequence mode on the Flight Plan page; or performs a Direct-To any other waypoint. The course from the active waypoint is based on one of the following two conditions: The computed course at the active waypoint; or a crew-entered course on the Flight Plan page. Prior to passing over the active waypoint, a waypoint alert indication will occur at the time to go specified on the Navigation Configuration page. At 10 seconds prior to the waypoint, the waypoint number on the Flight Plan page and the ↓ to ↓ indicator on the Lateral Steer page will flash for 10 seconds. As the waypoint is passed, the WPT PASSED annunciation will be displayed on the annunciation line and a FROM indication will be displayed on the title line of the Flight Plan and Lateral Steer pages. The FMS will continue to provide guidance to the outbound FROM course from the active waypoint.

To fly on a desired outbound course, perform the following steps.

1. Select **MAN** sequence mode on the Flight Plan page.
2. Select (via a Direct-To) or enter the desired active waypoint data.
3. Enter the desired course.

By selecting **MAN**, the new active waypoint is prevented from sequencing when it is inserted into the flight plan or the new desired course is entered. A new inbound course may also be manually entered when the sequencing mode is AUTO or FLYOVER, but entry is limited to $\pm$ 90° of the computed inbound course. If the aircraft is on the TO side or the waypoint after completing these steps, the aircraft must fly to that waypoint before it can fly the outbound (FROM) course as selected. If the aircraft is on the FROM side of the waypoint, the FMS will immediately initiate guidance to the desired outbound course and the TO indication will change to a FROM indication. See Figure 3B-33 for an example of execution of manual sequencing and course edits.

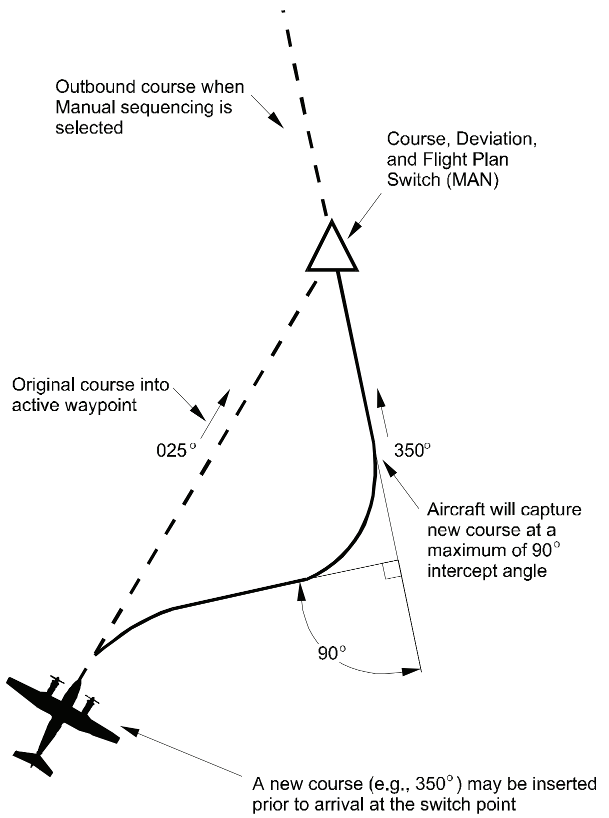


Figure 3B-31. Lateral Course Edit

(b) TACAN Emulation. Since the FMS provides the capability to fly a selected course TO or FROM the active waypoint (TO-FROM navigation), it can be used to perform emulation of TACAN navigation. The crew can enter, display, and fly the courses printed on the Instrument Flight Rules (IFR). En Route Low and High Altitude aeronautical charts for published airways or courses associated with VOR's, VORTAC's, VOR-DME's, or TACAN's. Refer to Figure 3B-34 and Table 3B-26 for a description of configuring the FMS for TACAN emulation. The steps to configure for TACAN emulation are the same as for manual sequencing and course edits, except that the new active waypoint must be the ICAO identifier for a VOR, VORTAC, VOR-DME, or TACAN. The FMS will provide guidance to the flight instruments, as it appears published on the aeronautical charts. If a DME arc is to be flown, the CDU Lateral Steering page continues to show the bearing and distance to the station (waypoint) as the arc is flown. Distance on the Lateral Steer page is always direct distance to the waypoint, not a path distance.

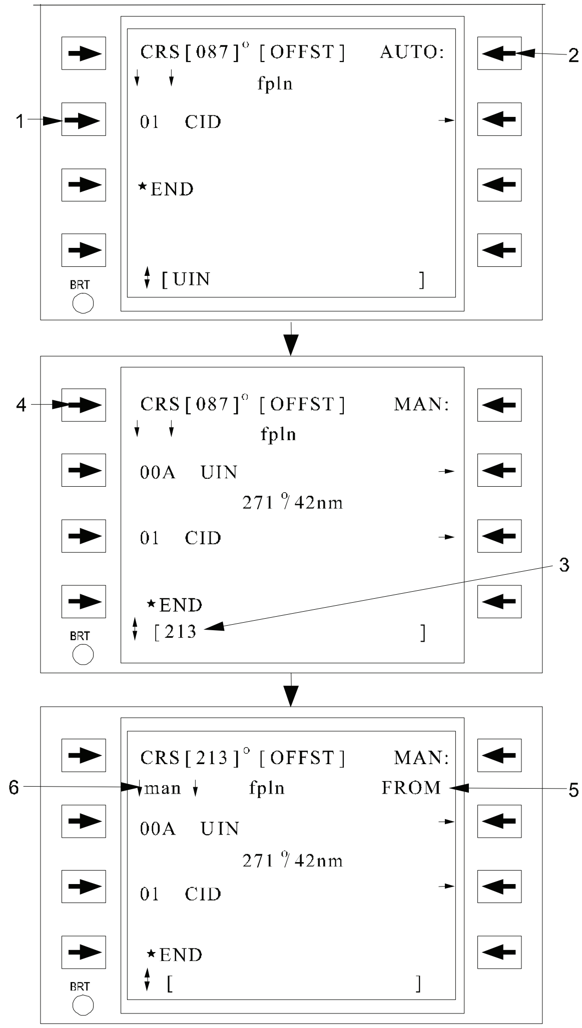


Figure 3B-32. Manual Sequencing and TACAN Emulation

Table 3B-26. Manual Sequencing and TACAN Emulation

NO.	DESCRIPTION/FUNCTION
1	Enter TACAN identifier or waypoint.
2	Select **MAN** advance (if desired) to prevent waypoint passage into history.
3	Enter the desired/published course in the scratchpad.
4	Enter the course to/from the waypoint.
5	A FROM indicator is provided when the station is passed. The waypoint does not move into history.
6	Indicates type of course entry: Computed (blank), Manual (man), or Direct-To computed (dir).

(c) Modifying the FROM Waypoint. When scrolling back into the history waypoints, the waypoint immediately preceding the active waypoint is the current FROM waypoint. The FMS normally provides steering to intercept the course between the FROM and TO waypoints. By entering a new FROM waypoint the FMS steers to intercept a new course between the newly entered FROM and original TO waypoints. Figure 3B-35 is an example of the effect of modifying the FROM waypoint on guidance to the active waypoint.

(6) Waypoint Steering Data. Once an active flight plan is entered, the FMS-800 computes the pilot's steering solution. The nomenclatures on the CDU refer to the steering data that is entered into the pilot's flight instruments.

(a) Display of Pilot's Steering Data. When the **STR** function key is pressed the CDU displays the Pilot's Lateral Steer page. Refer to Figure 3B-36 and Table 3B-27. The pilot's steering uses GPS as its single navigational source.

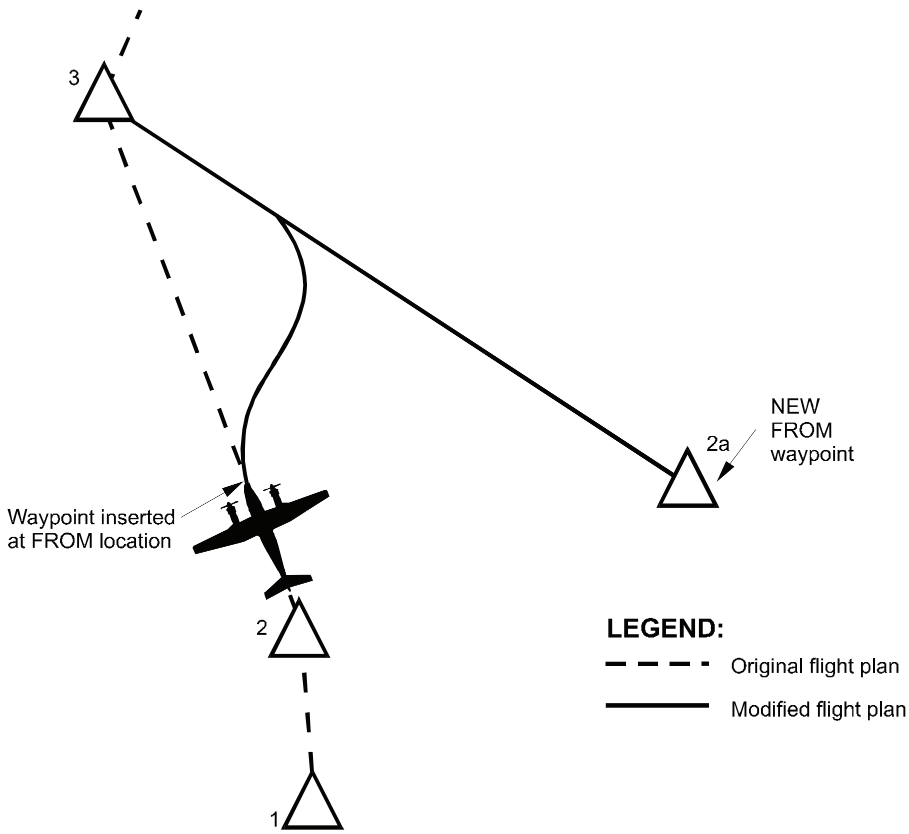


Figure 3B-35. Entry of a New FROM Waypoint

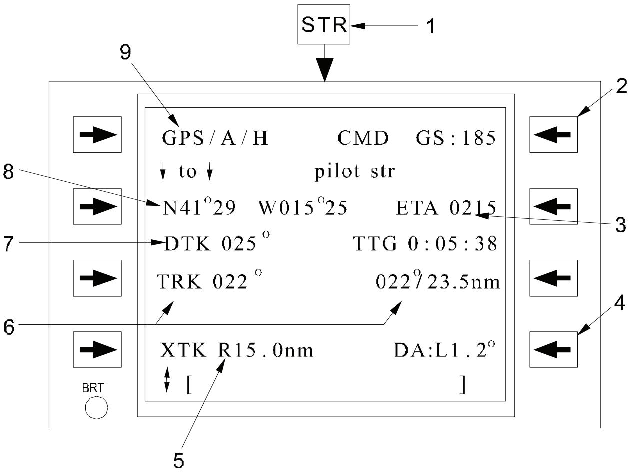


Figure 3B-36. Pilot's Lateral Steer Page

Table 3B-27. Pilot's Lateral Steer Page

NO.	DESCRIPTION/FUNCTION
1	Select Steering (STR) page.
2	Toggle between commanded ground speed (CMD GS), groundspeed error.
3	Estimated time of arrival and time to go to the active waypoint.
4	Toggle between Drift Angle (DA) and Track Angle Error (TKE) display.
5	Crosstrack deviation.
6	Current aircraft track and bearing/distance to go to the action deviation.
7	Desired track at present position to steer to active waypoint.
8	Active waypoint.
9	Source for pilot's steering solution.

(b) Speed Command for Required Time of Arrival (RTA).

NOTE

Current implementation of the RTA function is prohibited from use for Air Traffic Control (ATC) airspace operations.

A required RTA can be entered at one or more waypoints on the Flight Plan Waypoint Data page. If an alternate flight plan with RTA's at any waypoint is transferred to the active fight plan, the RTA's are maintained at the same waypoints and times. To delete a RTA enter a **–** in the scratchpad and select the **RTA** line select key on the Flight Plan Waypoint page.

To view the computed ground speed required to achieve the RTA, select the Pilot Lateral Steer page. The speed command is for the first future flight plan waypoint that has an RTA assigned.

If the crew desires to be alerted when the actual speed differs from the commanded speed, enter the desired threshold on the Navigation Configuration page. Refer to Figure 3B-37 and Table 3B-28. When the actual speed differs from the commanded speed by an amount greater than the entered threshold, a √SPEED annunciation will be displayed and CDU alert annunciator will be activated.

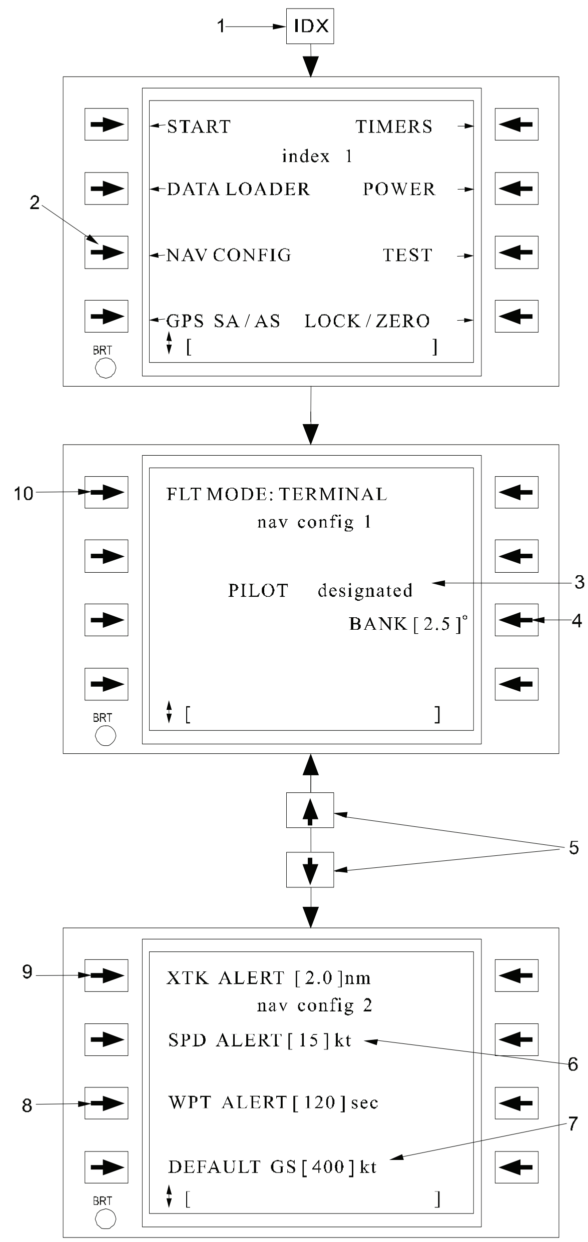


Figure 3B-37. Navigation Configuration Page

Table 3B-28. Navigation Configuration Page

NO.	DESCRIPTION/FUNCTION
1	Select Index page (**IDX**).
2	Select Navigation Configuration page.
3	Indication of designated pilot selection (always PILOT).
4	Entered Flight Plan Bank Limit.
5	Scroll vertically to access more configuration pages.
6	Entered Speed deviation alert threshold (knots).
7	Entered ground speed default for calculations while on the ground.
8	Entered waypoint alert time in seconds prior to waypoint arrival or leg switch.
9	Entered cross track deviation alert threshold (nautical miles).
10	Flight instruments scaling mode selection: OCEANIC, EN ROUTE, TERMINAL, or APPROACH.

(c) *Entry and Use of Waypoint Wind*. On the Flight Plan Waypoint page, a predicted wind can be entered for each waypoint in the flight plan. Refer to Figure 3B-38 and Table 3B-29. Wind entries are used with current True Airspeed to provide improved prediction for waypoint ETA and ETE as shown on the Lateral Steer page, Figure 3B-36.

When wind is entered at a future waypoint, the wind entry will be fixed at the entry waypoint and propagate through the flight plan to all subsequent waypoints. When new waypoints are inserted into the flight plan, the default wind for the new waypoint will be based on the previous waypoint's wind entry. When no wind entry is provided, the FMS uses current wind for predicted arrivals at the waypoint. The active waypoint wind will show the current wind conditions and entry is not permitted. The wind for history waypoints is the actual wind measured at waypoint passage, and entry is not permitted. Wind direction is entered in the direction from which the wind is blowing.

When transferring a flight plan from the alternate to the active flight plan, the waypoint wind entered in the alternate flight plan will be retained in the active flight plan definition.

(d) *Control and Display of Bank Command Limits and Crosstrack Deviation Alerting*. The bank command limit for the FMS steering and flight plan leg switching is controlled by the crew entering a value on the Navigation Configuration page.

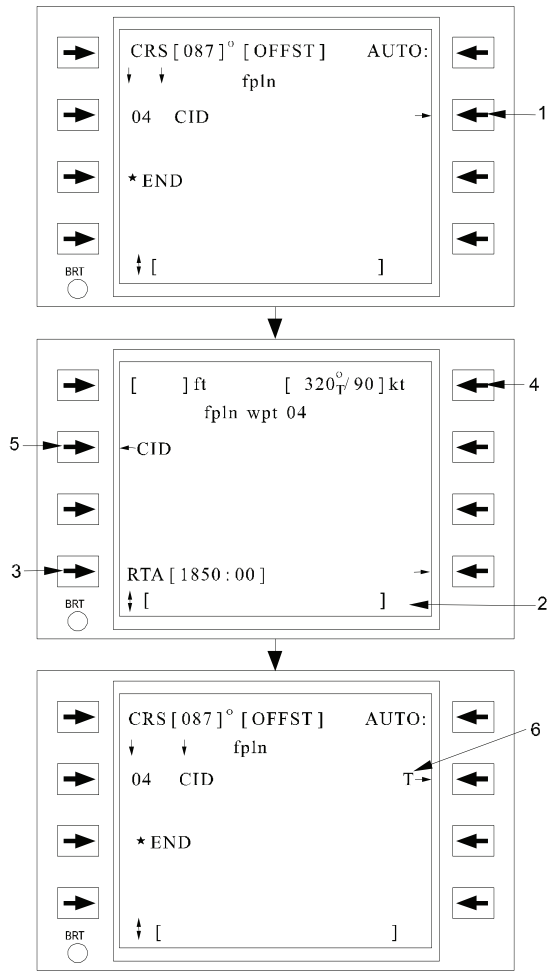


Figure 3B-38. Flight Plan Waypoint Page

Table 3B-29. Flight Plan Waypoint Page

NO.	DESCRIPTION/FUNCTION
1	Access Flight Plan Waypoint page.
2	Enter RTA into the scratchpad.
3	Select RTA line select key to insert RTA.
4	Entered wind for future legs (defaults to computed wind for current leg).
5	Return to the Flight Plan page.
6	T indicates RTA assigned to the waypoint. Entering a **–** and pressing this line select key will delete the RTA at this waypoint.

The bank command limit is used by the FMS guidance function to limit FMS commanded banks to the entered threshold. Turn anticipation for waypoint sequencing along the flight plan is adjusted according to the limit specified to minimize overshoot conditions.

On the Navigation Configuration page, the crew may enter parameters for the waypoint alert and cross track deviation threshold. Entering the number of seconds for the waypoint alert will set an alert anticipation that activates external waypoint annunciations on capsule lights or flight instrument displays the specified time before a waypoint transitions.

For cross track alerts, entering a value (in nautical miles) for the cross track annunciation will trigger an XTK ALERT when the cross track deviation exceeds the entered threshold value. This alert is inhibited during turns from one leg to the next.

(e) Selection of Flight Mode. On the Navigation Configuration page, the current mode of flight can be selected. The mode selection affects the lateral steering scaling and integrity determination of the GPS and INU/GPS navigation solutions. When powered up, the FMS defaults to TERMINAL mode until the aircraft has left the 30 nm terminal area around the origin airport. When the aircraft comes within 30 nm of the destination airport, the FMS automatically transitions back to the TERMINAL mode. When the aircraft reaches the Final Approach FIX (FAF) of an approach, the FMS automatically transitions to the APPROACH mode. Each flight mode can be manually overridden on the Navigation Configuration page.

(7) Oceanic Reporting Function. The FMS-800 provides an oceanic flight position reporting and trip log function to simplify crew procedures for these tasks.

(a) Data Access and Display. To view the Oceanic Mission page, first press the mission (MSN) function key on the CDU. Then select the Oceanic line key to display the Oceanic Reporting page. Refer to Figure 3B-39 and Table 3B-30. This page shows the current flight plan waypoints in sequence with each waypoint's respective ETA (for future waypoints) or Actual Time of Arrival (ATA) (for history waypoints). These may be read and reported without additional paging. A typical position report includes the time passing the most recent reporting point and the ETA's of the next three reporting points in UTC. The calculation of the active waypoint's ETA is based on current true airspeed and wind. All subsequent waypoint ETA's are calculated using current airspeed and either the current default or pilot-entered leg wind for subsequent legs.

Each time a waypoint is passed into history, the ATA is recorded by the FMS. To view this trip log of waypoint passage times, scroll the list upward to view the history waypoints and their ATA's. If waypoints have been bypassed via a Direct-To operation, dashes are displayed for the ATA.

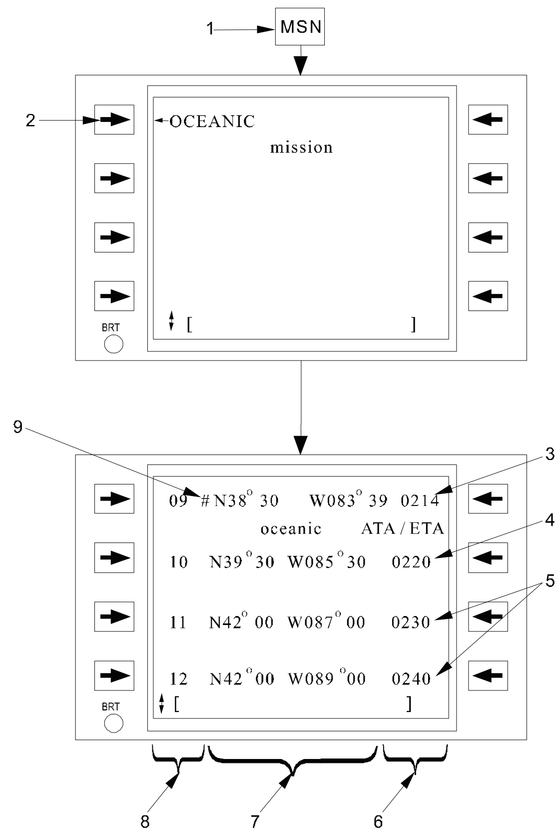


Figure 3B-39. Oceanic Mission Pages

Table 3B-30. Oceanic Mission Pages

NO.	DESCRIPTION/FUNCTION
1	Press Mission Function Key - **MSN**.
2	Select OCEANIC page.
3	FROM waypoint (ATA).
4	TO waypoint (ETA).
5	Subsequent waypoints (ETA).
6	Waypoint ATA's or ETA's.
7	Waypoint positions or ID's.
8	Waypoint numbers.
9	A # indicates the waypoint is a history waypoint.

f. Direct-To Operations.

(1) Direct-To Overview. Direct-To courses are used to either bypass existing waypoints in the flight plan or to insert an impromptu waypoint, interrupting the current leg. In each case a system generated turn point is used to calculate the course to the newly selected active waypoint. This system's generated turn point provides turn anticipation and prevents S turns during capture of the new course. The system's generated turn point is calculated internally and not displayed to the operator. The Direct-To function differs from simple active waypoint entry by the course being set from the aircraft position rather than from the last history waypoint. When used during Vertical Navigation (VNAV), the Direct-To function computes an immediate climb or descend path to a waypoint with an altitude crossing assigned.

When the **DIR** line select key is pressed, the Flight Plan page is accessed with DIR TO [ ] displayed on the top line. Refer to Figure 3B-40 and Table 3B-31.

After selecting a waypoint for the Direct-To operation, the normal Flight Plan page display will return.

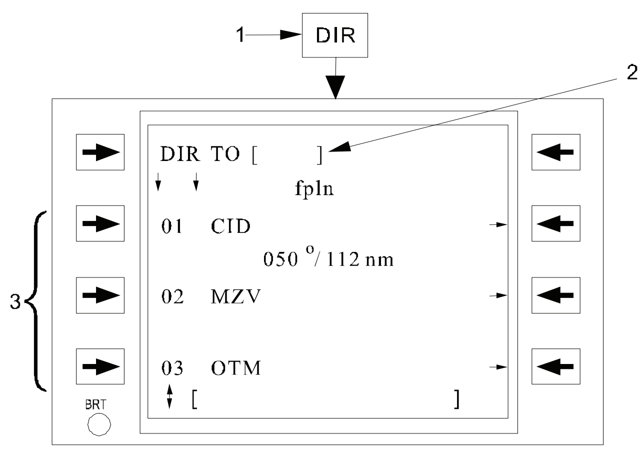


Figure 3B-40. Direct-To Line Select Key

Table 3B-31. Direct-To Line Select Key

NO.	DESCRIPTION/FUNCTION
1	Press Direct Function Key - **DIR**.
2	DIR TO [ ] label remains on line 1 as waypoints are scrolled to indicate that only Direct-To operations are possible.
3	Flight plan edits (i.e., waypoint insertion and deletion, and labeling) are permitted.

(2) Direct-To Flight Plan Waypoints. A Direct-To course may be initiated to any existing flight plan waypoint including the history waypoints. DIR TO [ ] remains on the top line as the flight plan is scrolled to indicate that Direct-To selections may be made. Refer to Figure 3B-41 and Table 3B-32. If the waypoint selected for the Direct-To operation is a future waypoint the intermediate waypoints are bypassed and moved into the flight plan history list (up to 39 waypoints). If the selected waypoint is a history waypoint, the history waypoints following the Direct-To waypoint are moved into the future flight play list and repeated in their original sequence. If any manual edits were made to the courses between flight plan points, they will be reset to the original courses once they become history points.

A Direct-To to the MAP of an approach procedure is prohibited. The FMS must sequence through the FAF waypoint for the MAP to become the active waypoint.

If the pilot has selected the FMS navigation source on the Electronic Horizontal Situation Indicator (EHSI), the Direct-To course may also be activated to the current active waypoint by momentarily pressing the **CRS** select knob on the Flight Display System (FDS) control panel. This single action Direct-To capability is useful in situations where the pilot must deviate from a course and wishes to proceed directly to the waypoint. It is also useful in terminal area maneuvering in conjunction with GPS data based approaches.

NOTE

The FMS-800 creates a Direct-To course between the turn anticipation point directly ahead of aircraft present position and the selected direct-to waypoint. When the change in the resulting course is greater than 150°, the FMS will provide guidance to turn and intercept this course, resulting in an S-turn maneuver to the course.

(3) Direct-To DME Arc Procedure. A Direct-To a future or history waypoint that is the endpoint of a DME arc will cause the FMS to intercept the arc along the DME arc leg. To fly directly to the waypoint without intercepting the arc, select Direct-To the DME Arc endpoint again while it is the active waypoint to override the DME Arc leg intercept.

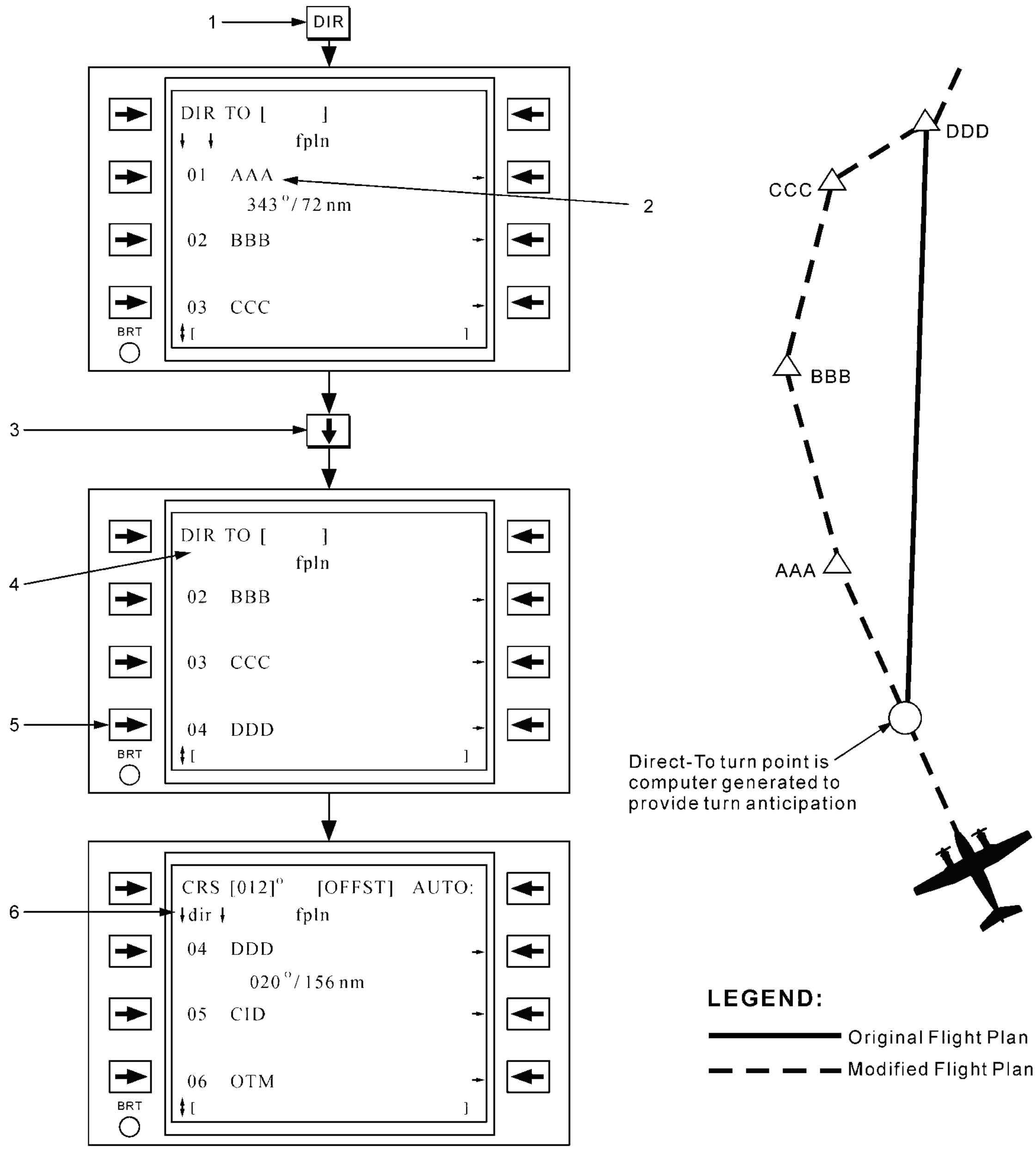


Figure 3B-41. Direct-To a Flight Plan Waypoint

Table 3B-32. Direct-To a Flight Plan Waypoint

NO.	DESCRIPTION/FUNCTION
1	Press Direct Function Key – **DIR**.
2	Indicates the active waypoint.
3	Scroll to the desired waypoint DDD.
4	The double arrows will disappear when scrolled away from the active waypoint.
5	Select the desired waypoint.
6	When the Direct-To becomes the active waypoint, the course indicator displays dir.

(4) Direct-To Impromptu Waypoints. Impromptu waypoints may be inserted into the flight plan interrupting execution of the current flight plan leg. The impromptu point may be any valid waypoint

format. Refer to Figure 3B-42 and Table 3B-33 and Figure 3B-43 and Table 3B-34 for an illustration of the two methods of executing Direct-To operations to impromptu waypoints. When performing a Direct-To the scratchpad waypoint, the active waypoint will be pushed one waypoint into the future and the scratchpad waypoint becomes the new active waypoint. When the MAP is the active waypoint, executing a Direct-To the scratchpad waypoint will move the MAP into history (not future), allowing departure into a missed approach procedure. Waypoint insertion between the FAF and the MAP is prohibited, even when the FAF is in history.

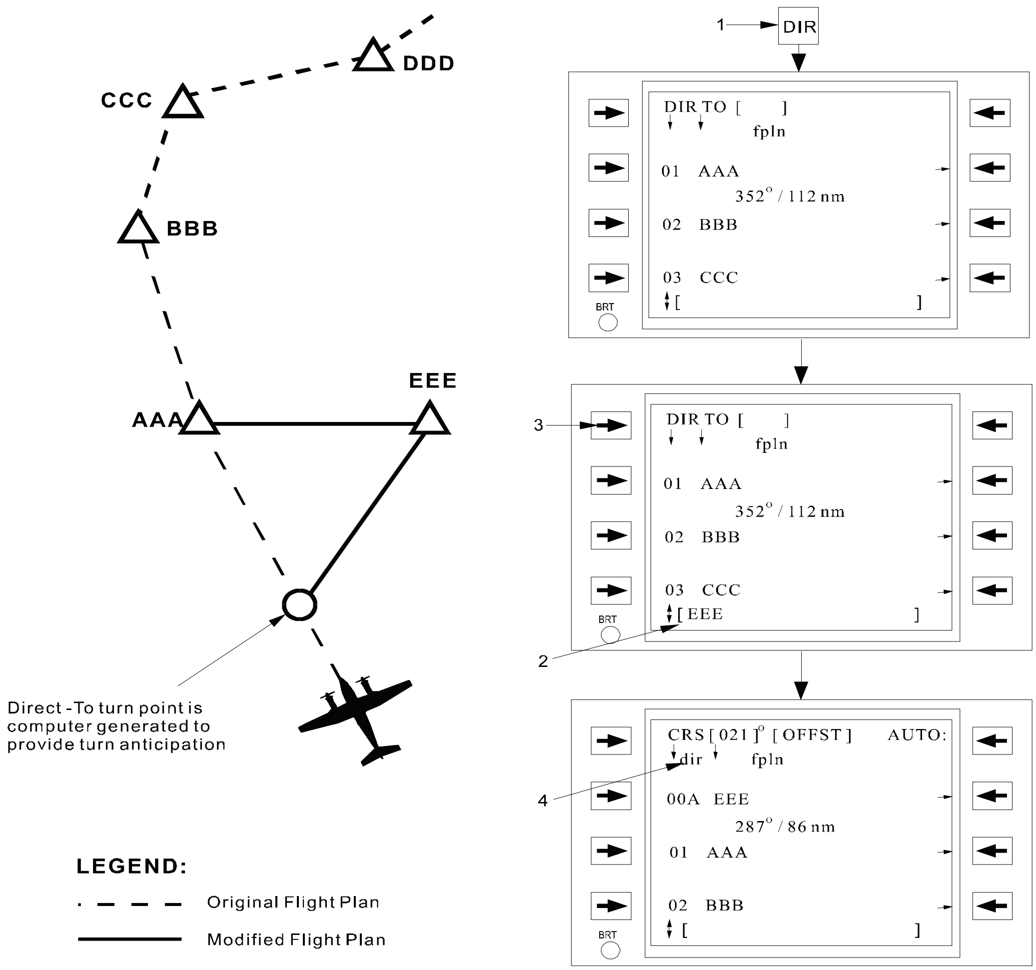


Figure 3B-42. Direct-To an Impromptu Waypoint

Table 3B-33. Direct-To an Impromptu Waypoint

NO.	DESCRIPTION/FUNCTION
1	Press Direct Function Key - **DIR**.
2	Enter waypoint in scratchpad.
3	Insert impromptu waypoint.
4	When the Direct-To becomes the active waypoint, the course indicator displays dir.

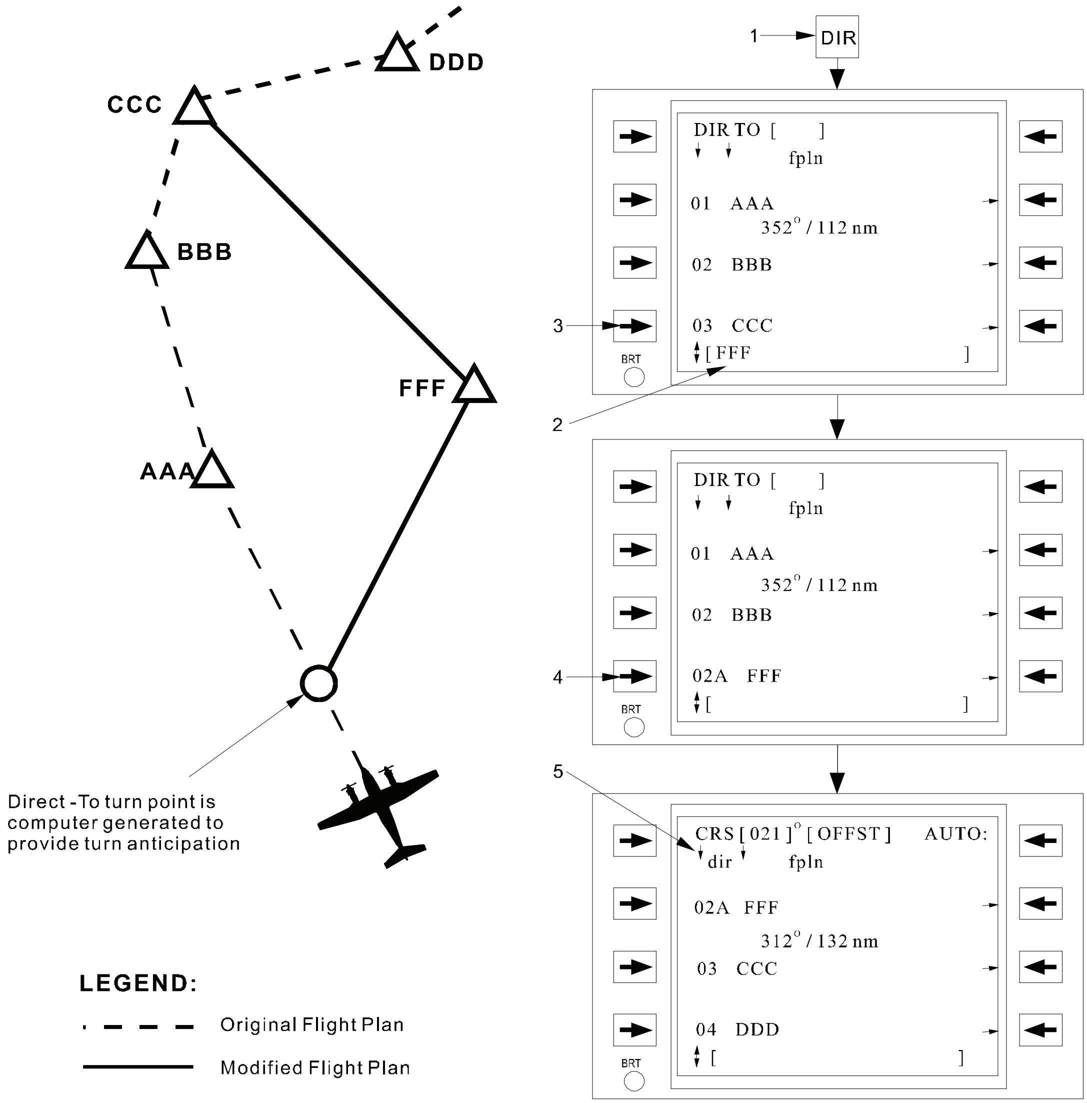


Figure 3B-43. Direct-To Impromptu Waypoint Inserted as a Future Flight Plan Waypoint

Table 3B-34. Direct-To Impromptu Waypoint Inserted as a Future Flight Plan Waypoint

NO.	DESCRIPTION/FUNCTION
1	Press Direct Function Key - **DIR**.
2	Enter desired impromptu location in the scratchpad.
3	Insert impromptu location after intervening flight plan waypoints.
4	Press line select key a second time to execute a Direct-To the same point.
5	When the Direct-To becomes the active waypoint, the course indicator displays dir.

To execute a Direct-To the non-flight plan waypoint that is stored within the FMS, like a Markpoint, copy the desired waypoint into the scratchpad, select **DIR**, select line select 1L to activate the Direct-To the scratchpad waypoint.

(5) Direct-To Vector From Present Position. The impromptu point may also be defined as a vector from the present position of the aircraft. Vector waypoints are handled in exactly the same manner as a normal waypoint except that the FMS-800 computes the waypoint position from present position. Refer to Figure 3B-44 and Table 3B-35.

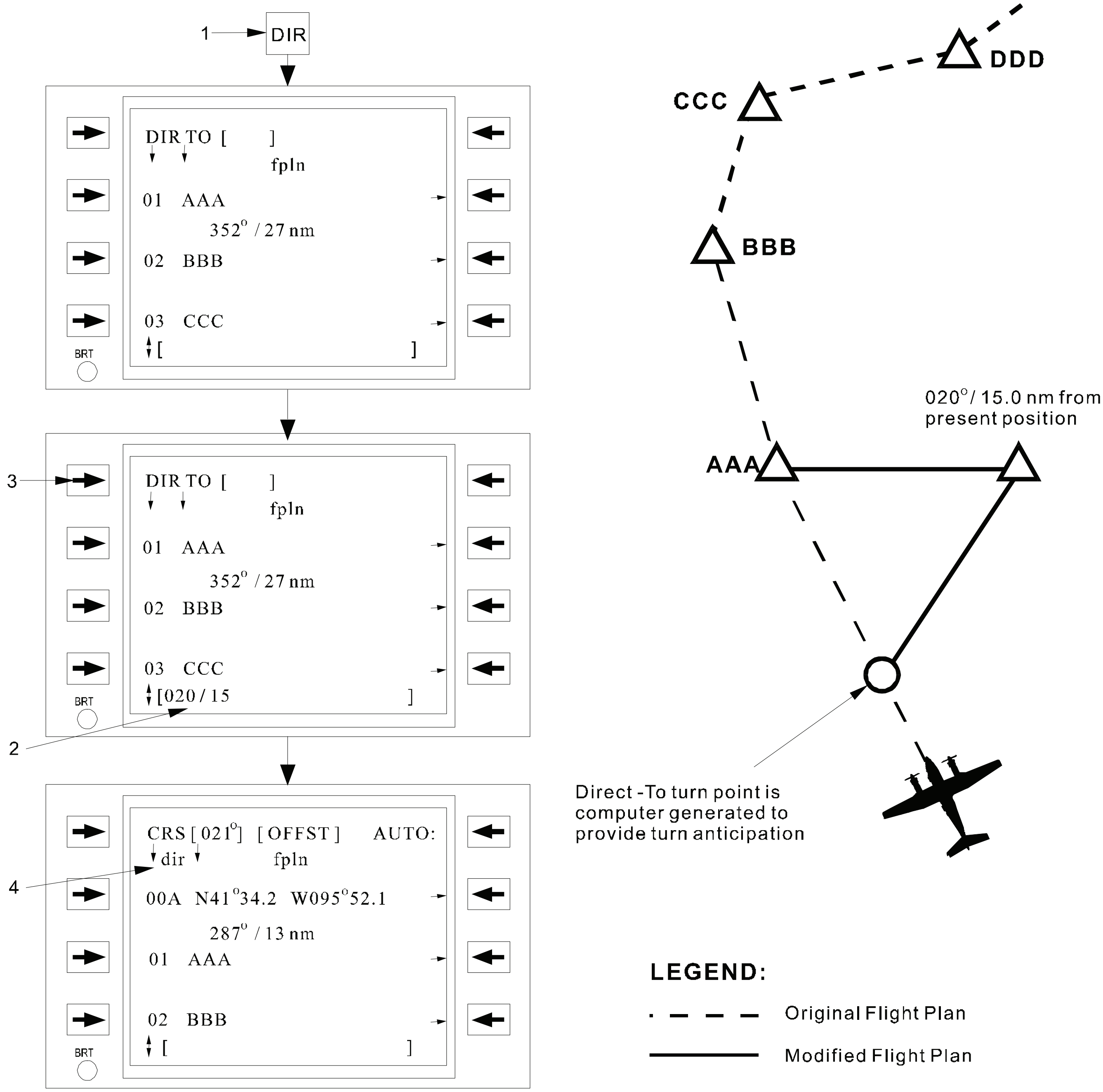


Figure 3B-44. Direct-To Vector From Present Position

Table 3B-35. Direct-To Vector From Present Position

NO.	DESCRIPTION/FUNCTION
1	Press Direct Function Key - **DIR**.
2	Indicates the desired vector location (Bearing/Distance from present position).
3	Press line select key **DIR TO [ ]**.
4	When the Direct-To becomes the active waypoint, the course indicator displays dir.

g. **Parallel Course Offsets.**

NOTE

Offsets may be defined to the left or right or the original course. Once applied they remain in effect for the remainder of the flight plan unless canceled.

(1) Parallel Course Offset Geometry. A parallel course offset may be applied to the flight plan for weather or traffic avoidance or when assigned by Air Traffic Control (ATC). When an offset is applied, all displays keyed to the active waypoint (e.g., time and distance to go, TO / FROM flag) become referenced to the pseudo-waypoint at the intersection of the course change bisector and the offset course. The leg switch point and the associated 10-second alert are computed relative to the pseudo-waypoint. Crosstrack deviation is computed relative to the offset course. Figure 3B-45 shows the geometry associated with waypoint switching when a parallel offset is applied.

NOTE

Executing Direct-To a waypoint will cancel a parallel course offset if one has been applied.

(2) Parallel Offset Initiation, Termination, Or Change. Parallel course offsets may be applied, changed, or deleted any time the active waypoint is not identified as a pattern or an approach waypoint. Refer to Figure 3B-46 and Table 3B-36 for an illustration of application and deletion of parallel course offset. If the waypoint identified as a pattern or an approach waypoint fix becomes the active waypoint or FLYOVER sequencing is selected while an offset is defined, the offset is automatically canceled and the aircraft will capture the original flight plan course. If a pattern or approach is applied to an active waypoint with an offset applied, the offset is automatically canceled. Initiation of the Direct-To function automatically cancels the parallel offset. Refer to Figure 3B-47.

An OFST annunciation on the Horizontal Situation Indicator (HSI) or external OFFSET capsule light annunciation is activated whenever an offset is action.

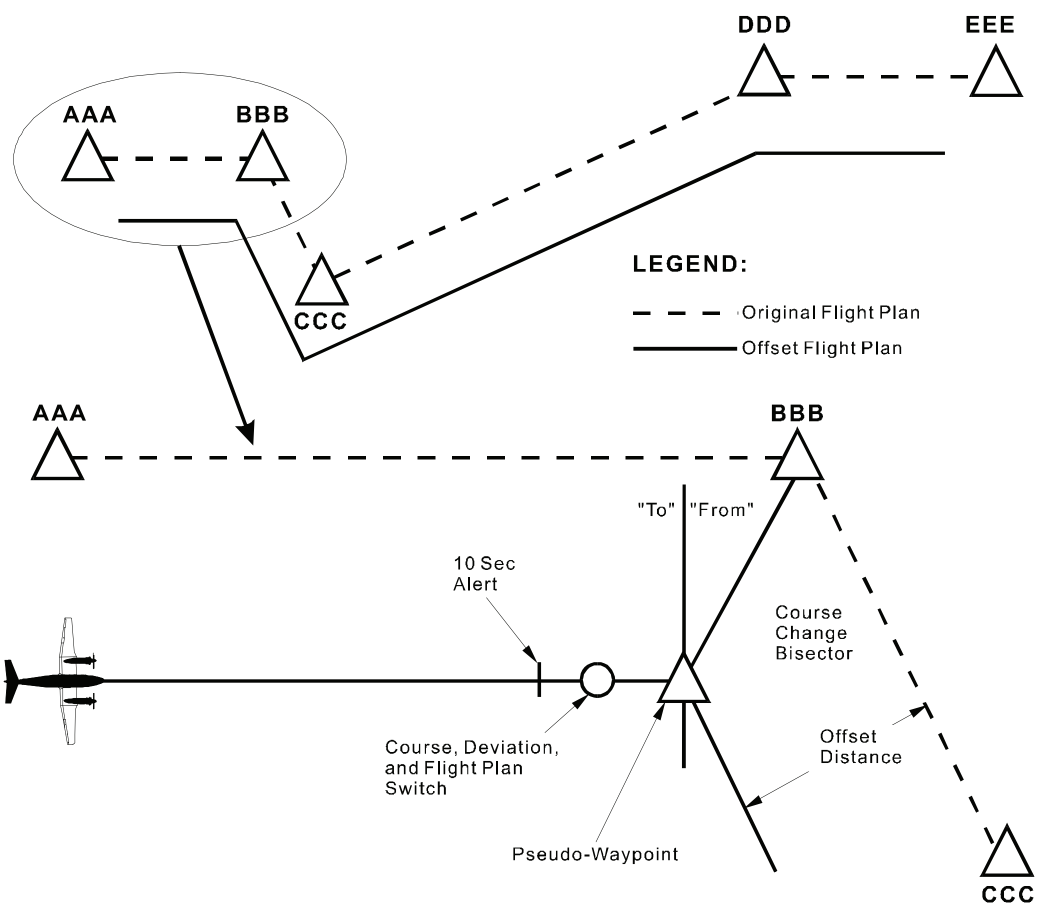


Figure 3B-45. Parallel Course Offset Geometry

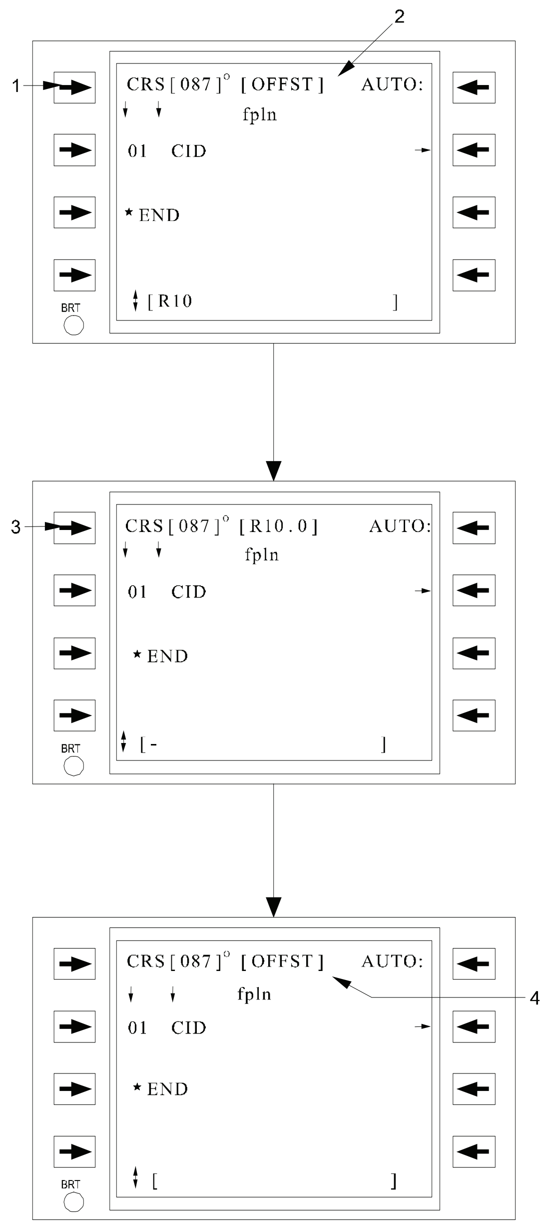


Figure 3B-46. Entering and Deleting Parallel Course Offsets

Table 3B-36. Entering and Deleting Parallel Course Offsets

NO.	DESCRIPTION/FUNCTION
1	Insets a parallel course offset. Right or left must be specified as the first character (e.g. RO.4, R5, L7.0, L12.8).
2	The current value for parallel course offset, or OFFST if none is defined.
3	Deletes a parallel course offset if the scratchpad contains **–**, 0.0, 0., .0, or 0.
4	Display is returned to [OFFST].

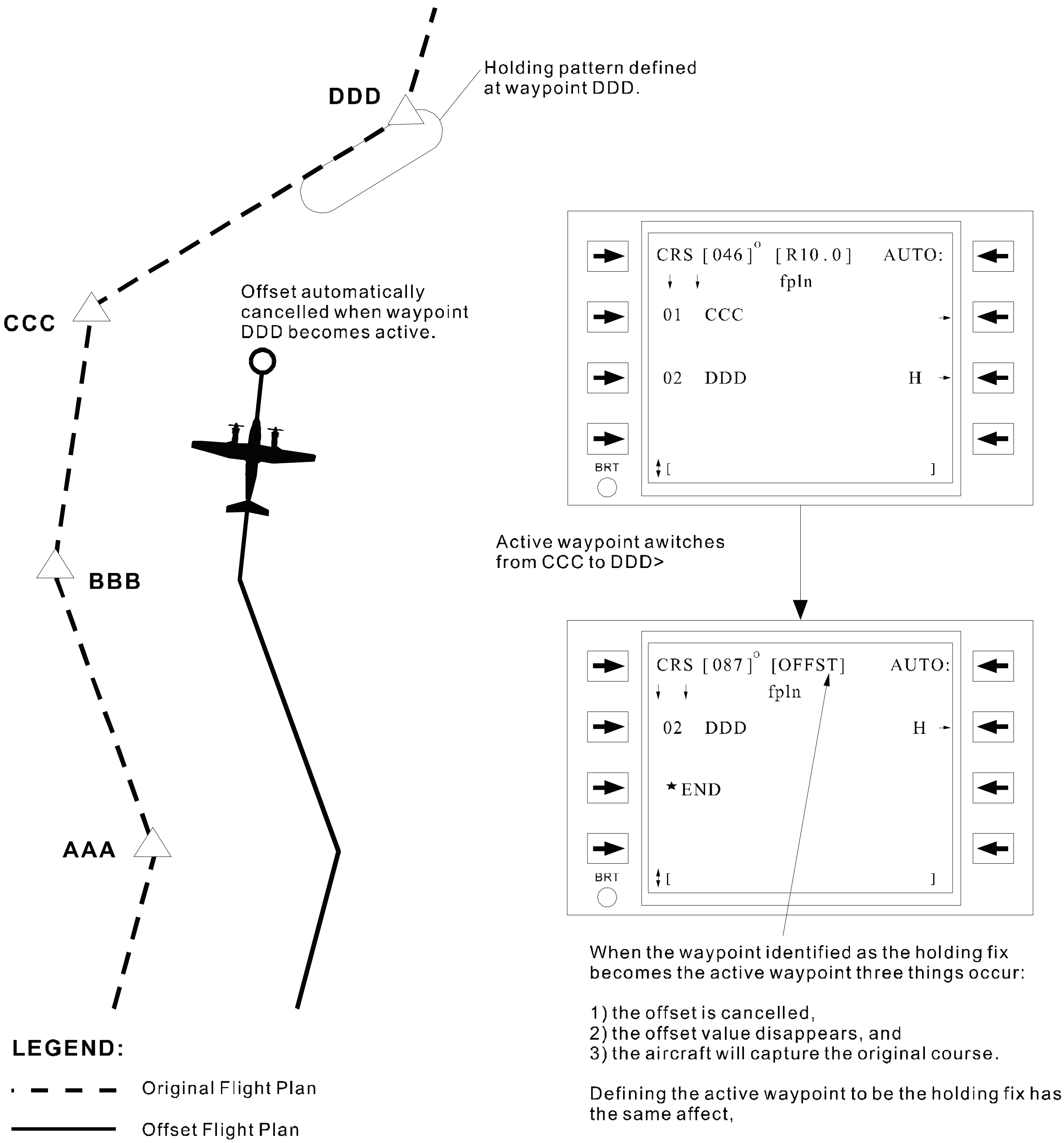


Figure 3B-47. Automatic Cancellation of Parallel Course Offsets

(3) Waypoint Transition with Parallel Offsets. The parallel offset flight plan may result in severe geometry at waypoints with large course changes. To resolve this condition the offset pseudo-waypoint is never displaced along the inbound leg track by more than two times the width of the offset. Figure 3B-48 shows an offset definition where the along track shift of the pseudo - waypoint is less than two times the offset width, resulting in a continuous offset flight plan.

If a leg course change is greater than 127°, a course discontinuity is created. Upon reaching the switch point the new offset course for the next leg becomes active. Figure 3B-49 shows examples with the offset on both the inside and outside of the required turn.

h. Vertical Navigation.

(1) Vertical Navigation (VNAV) Overview. The FMS-800 VNAV function provides guidance for a climb or descent to an assigned altitude at a waypoint or crossing fix in STAR or initial approach procedure. It also provides situational awareness for climb and descent planning and allows fuel-efficient descents with adjustments for actual wind.

Vertical guidance is not provided during holding pattern, DME arc, course reversal, intercept, or pattern execution. Also, it is not provided for vertical path segments that extend into the previous flight plan leg.

(2) Assigning an Altitude or Flight Level. VNAV guidance requires an altitude or Flight Level (FL) to be entered at a waypoint in the flight plan. If an active flight plan is transferred from the alternate flight plan, all altitudes assigned at waypoints are also transferred. When an altitude has been assigned to a waypoint it is indicated by a V attribute on the right side of the Flight Plan page waypoint line. To delete this altitude assignment enter a dash – and press the right adjacent line select key, or press the upper left line select key if on the Flight Plan Waypoint page.

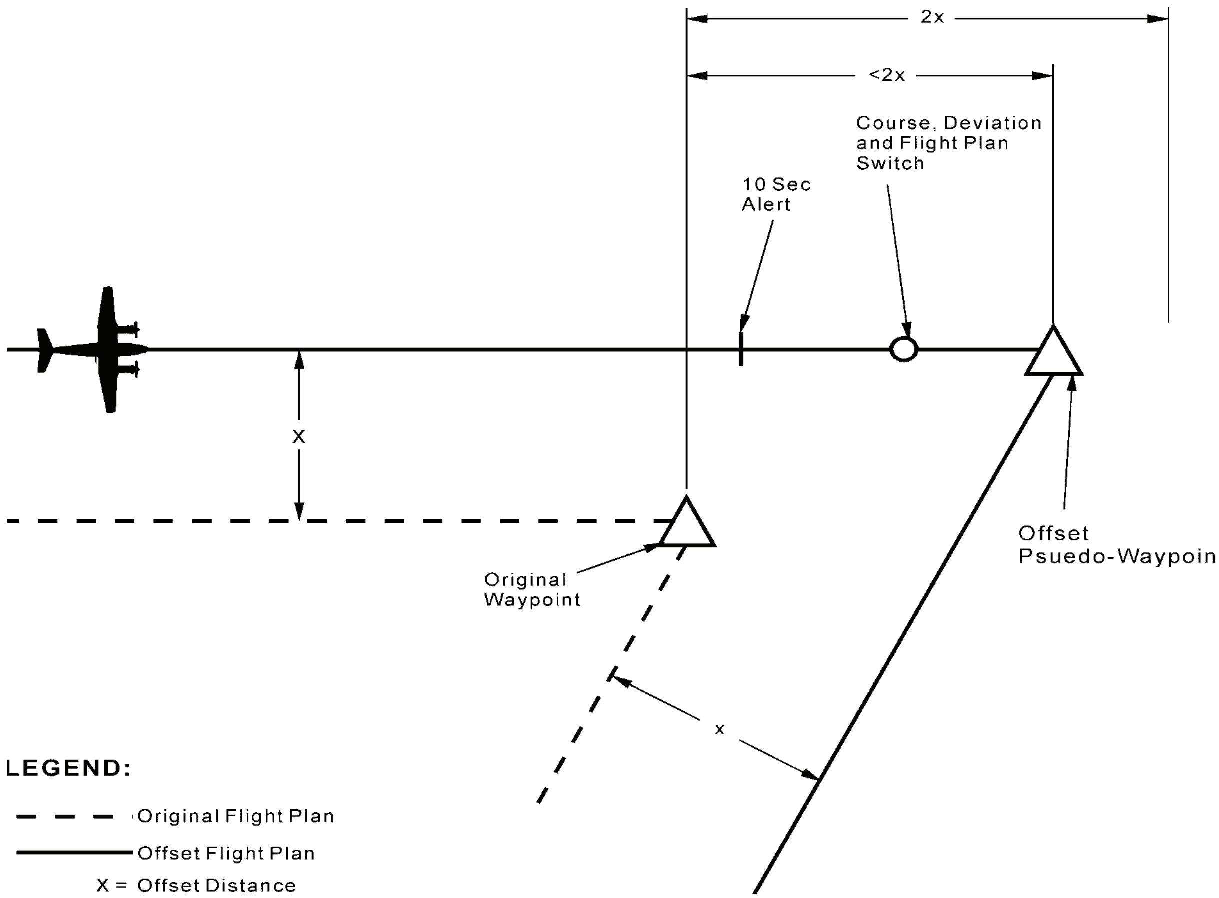
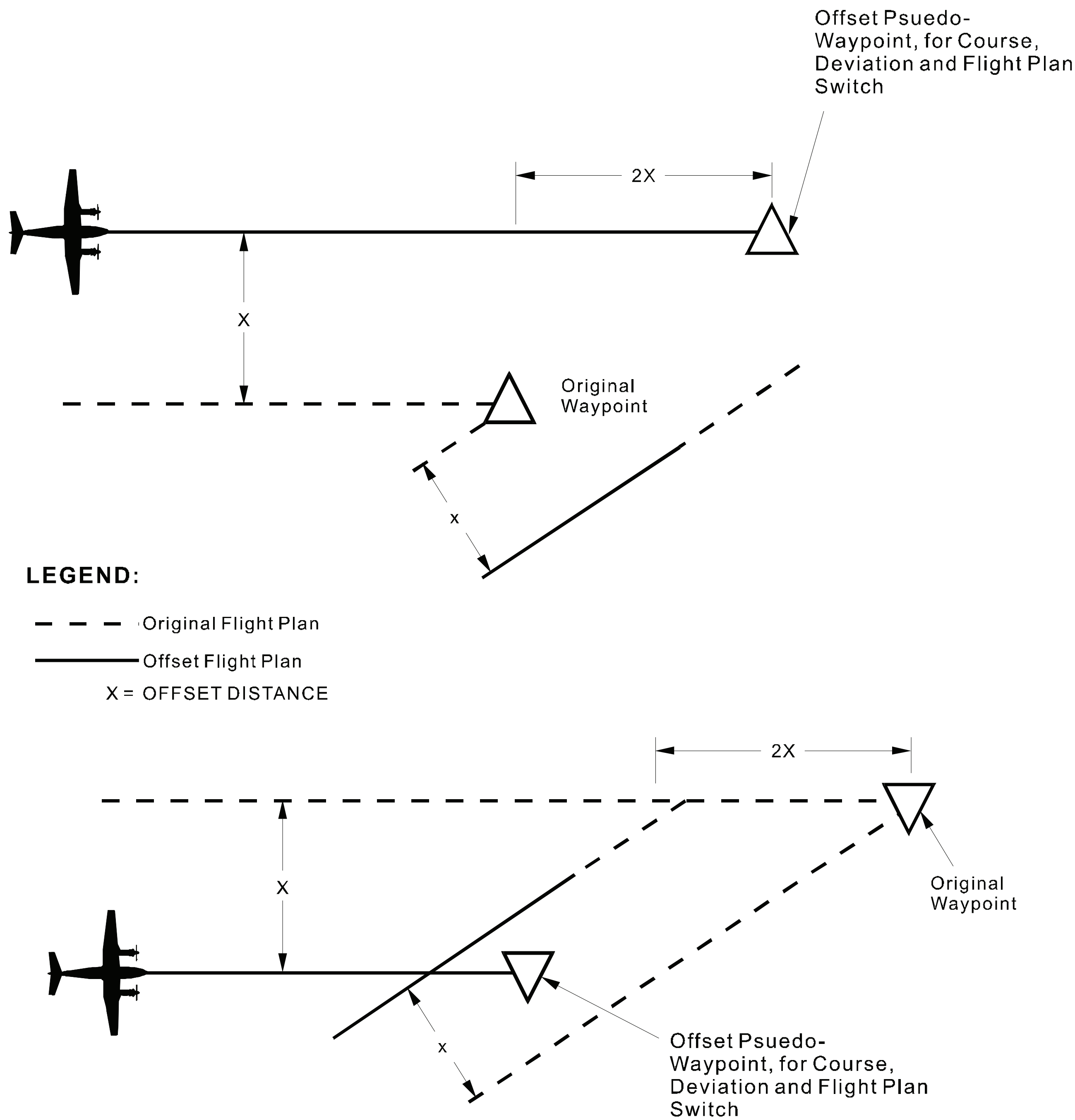


Figure 3B-48. Normal Parallel Offset Transition



NOTE
Aircraft overflies pseudo-waypoint and turns to capture the next course (S-turns likely).

Figure 3B-49. Parallel Offset Transition with Large Course Change

To enter an altitude select the Flight Plan Waypoint page for the waypoint where it is to be assigned. Refer to Figure 3B-50 and Table 3B-37. Altitudes are entered in feet and are automatically referenced by the FMS-800 to the local baroset. If a flight level is desired enter FL followed by the three-digit flight level. This indicates that the altitude is referenced in the FMS-800 to the flight level pressure datum (29.92 in. Hg) instead of the local barometric pressure. The FMS-800 automatically computes the guidance through the transition altitude (climbs) or transition flight level (descents) if the above procedure is followed, regardless of where the transition takes place, which may vary in different countries.

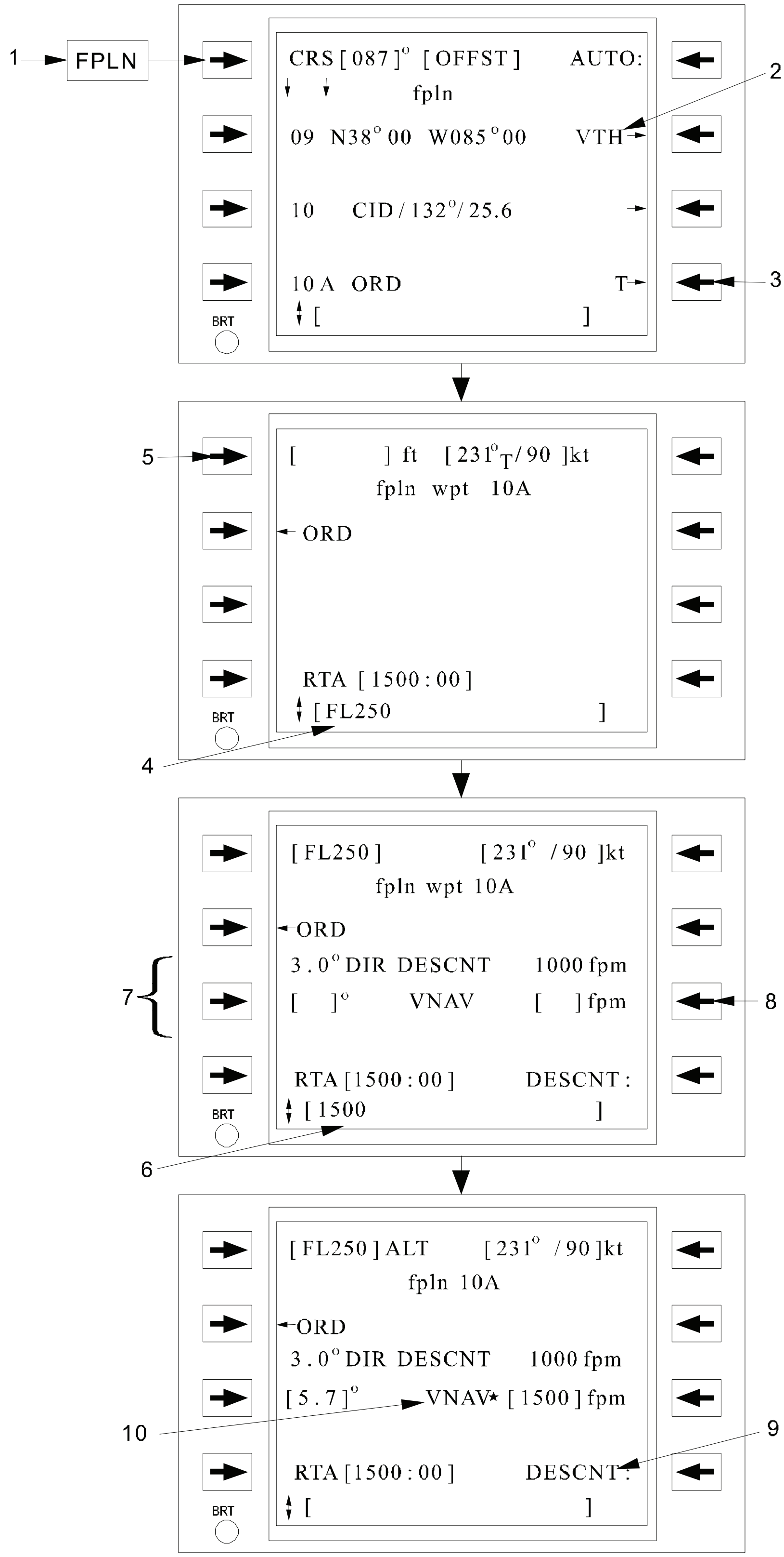


Figure 3B-50. Entry and Display of VNAV Parameters

Table 3B-37. Entry and Display of VNAV Parameters

NO.	DESCRIPTION/FUNCTION
1	Press Flight Plan Function Key - **FPLN**.
2	V indicates an altitude has been assigned at this waypoint.
3	Press right line select key to access Flight Plan Waypoint page for desired waypoint.
4	Enter flight level (or altitude) in the scratchpad.
5	Press altitude line select key to insert flight level (or altitude).
6	Enter vertical rate (or angle) in the scratchpad.
7	The VNAV information is displayed.
8	Press the insert rate (3R) or angle (3L).
9	Toggle between **CLIMB** and **DESCNT** selections.
10	Asterisk indicates rate is the fixed or entered quantity; after VNAV capture, the angle becomes fixed and vertical speed becomes variable with groundspeed.

If the waypoint is an FMS approach MAP, the altitude is displayed, but no entry is permitted. If an angle is associated with the MAP altitude, the V attribute will be displayed on the Flight Plan page. On MDA approaches, no descent angle is defined for the approach, so vertical guidance is disabled and the V attribute is not displayed.

(3) Entry and Display of Climb or Descent Path. If only an altitude/flight level is entered and no climb or descent path is specified, the climb/descent path is undefined and no vertical guidance is provided. To activate vertical guidance to the assigned altitude, either a climb/descent path rate or angle must be defined, or a Direct-To VNAV will be executed.

If two consecutive waypoints are assigned altitudes/flight levels, the default path is a straight-line climb or descent between them, same as for a published profile descent.

To specify a climb/descent path other than the default, enter the desired angle (0.0 to 6.0 degrees) or initial vertical rate (0 to 3500 fpm). Press the **VNAV** line select key for angle or rate entry. Refer to Figure 3B-51 and Table 3B-38. Select either **CLIMB** or **DESCNT** line select key on the Flight Plan Waypoint page.

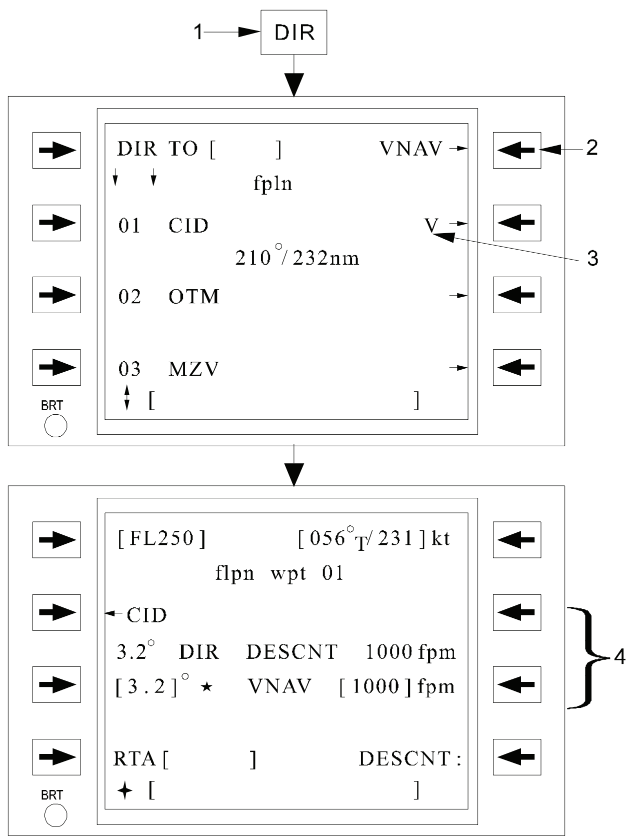


Figure 3B-51. VNAV Direct-To

Table 3B-38. VNAV Direct-To

NO.	DESCRIPTION/FUNCTION
1	Press the Direct function key - **DIR**.
2	Select VNAV Direct-To the active waypoint, if it has an altitude/flight level assigned (indicated by the V attribute). If the waypoint on line 3 does not have an altitude/flight level assigned the VNAV label is blanked.
3	Indicates V attribute.
4	VNAV CLIMB/DESCNT path synchronizes to the Direct-To path.

If an angle is entered, the vertical rate will be dynamically updated based on the angle prior to and during capture and the subsequent vertical path. An * will appear next to the angle value to indicate that it is fixed. If a vertical rate is initially entered, the angle is updated based on the entered rate prior to the capture points plus an asterisk appears next to the rate. At capture of the vertical path, the angle becomes fixed and the entered rate is now updated during the climb/descent. The asterisk is now displayed next to the angle to indicate the fixed value.

(4) Direct Climb or Descent Path Display. The DIRECT CLIMB/DESCNT vertical rate or angle on the Flight Plan Waypoint page is computed based on the FMS-800 present position and altitude for any waypoint with an altitude assigned, not just for the active waypoint. Refer to Figure 3B-52 and Table 3B-39. This advisory enables the pilot to plan his climb or descent. He is apprised of the actual vertical maneuver required. For example, ATC delays his climb/descent clearance beyond the planned Bottom Of Climb (BOC) or Top Of Descent (TOD), or clears the aircraft Direct-To another waypoint using the specified waypoint altitude. This is also the value that will be inserted if the pilot were to select a VNAV Direct-To.

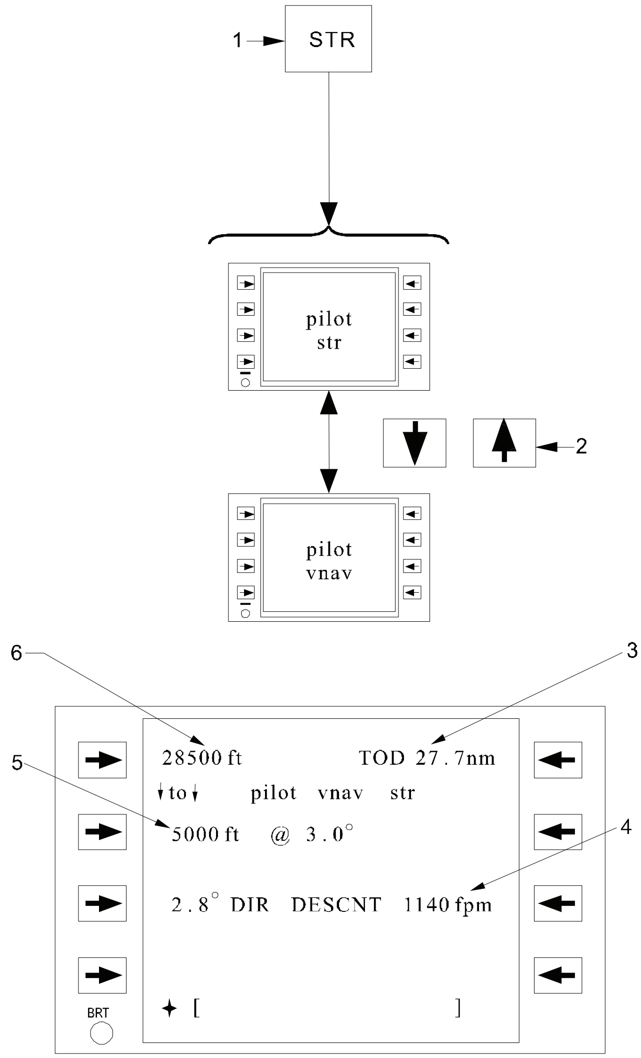


Figure 3B-52. VNAV Steering Pages

(5) VNAV Direct-To. To perform a VNAV Direct-To climb or descent, follow the procedures specified in Figure 3B-53.

Table 3B-39. VNAV Steering Pages

NO.	DESCRIPTION/FUNCTION
1	Pressing the Steering function key - **STR** will access the last viewed Steering page.
2	Scrolls vertically between the Steering pages.
3	Indicates the distance to BOC/TOD.
4	Indicates direct VNAV guidance.
5	Specified altitude/flight level and path angle to the active waypoint.
6	Current aircraft altitude.

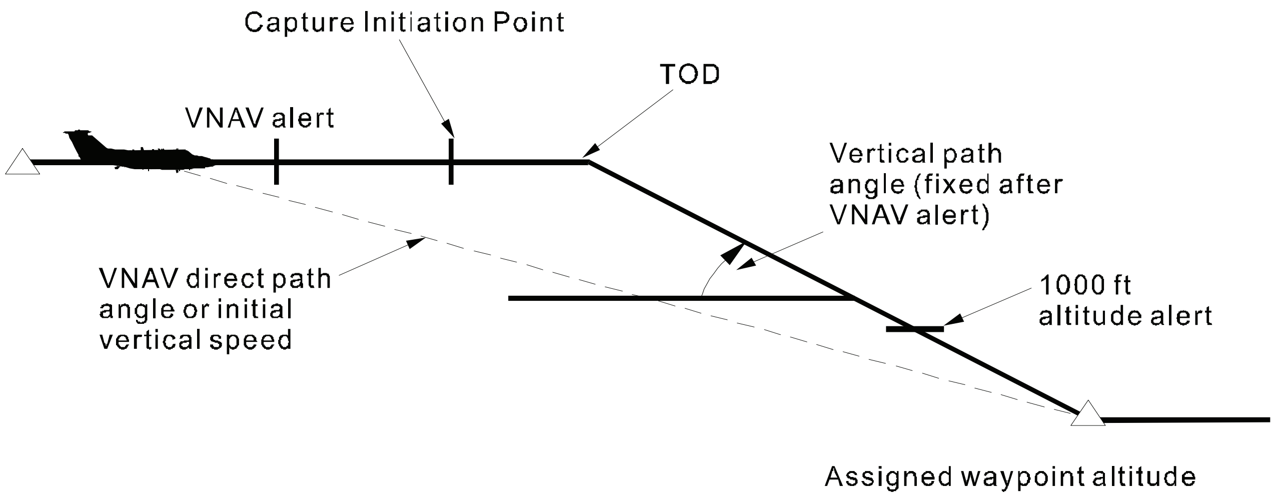


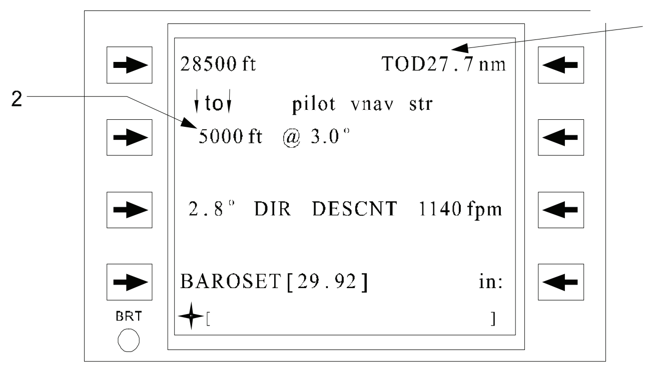
Figure 3B-53. VNAV Profile

(6) VNAV Guidance and Alerting. After a waypoint with an altitude becomes active the FMS-800 provides vertical steering to fly the entered or default VNAV climb or descent path. On the Pilot VNAV Steering page, Figure 3B-54 and Table 3B-40, the specified VNAV path parameters are displayed on data line 2. The continuously updated altitude is on data line 1 and the vertical rate and angle for a direct vertical path to the waypoint are presented on data line 3.

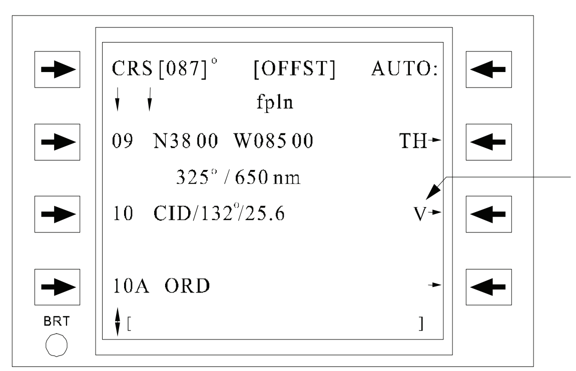
Prior to VNAV capture the distance to the BOC/TOD is displayed. This display is dashed after the VNAV path is captured.

Figure 3B-54 and Table 3B-40 show a typical VNAV profile along with the alerts associated with the VNAV capture and termination. Ten seconds prior to the VNAV path capture, the CDU page alerts flashes. At an altitude 1000 feet below/above the waypoint crossing altitude, a second alert is issued.

When the active waypoint for the VNAV guidance passes into history or is deleted, the VNAV steering parameters become invalid or are reset to their default values for the next vertical waypoint in the flight plan.



VNAV Steering Page



Flight Plan Page

Figure 3B-54. VNAV Capture and Termination Alerts

Table 3B-40. VNAV Capture and Termination Alerts

NO.	DESCRIPTION/FUNCTION
1	TOP OF DESCENT label flashes 10 seconds prior to VNAV capture (same for BOC).
2	Altitude flashes at 1000 feet above/below waypoint crossing altitude.
3	V attribute flashes 10 seconds prior to VNAV capture and at 1000 feet above/below waypoint crossing altitude.

i. Flight Instrument and Autopilot/Flight Director Guidance.

(1) Flight Instrument Displays. The FMS-800 provides lateral and vertical navigational situation information to the pilot's flight displays. The pilot's displays are driven using the navigational solutions from the CDU Pilot Steering page, Paragraph 3B-19.e.(6)(a).

(2) Horizontal Situation Displays (HSI). In order to display horizontal situational data on the EHSI, the FMS source must be selected by the pilot. The EHSI data includes the HSI course arrow (desired track), TO / FROM pointer, and bearing pointer to the FMS-800 outputs. These outputs always relate to the flight plan active waypoint or pattern turn point. Refer to Figure 3B-55 and Table 3B-41. If the EHSI distance interface is compatible and aircraft switching is installed, the distance readout will also show great circle distance to the active waypoint.

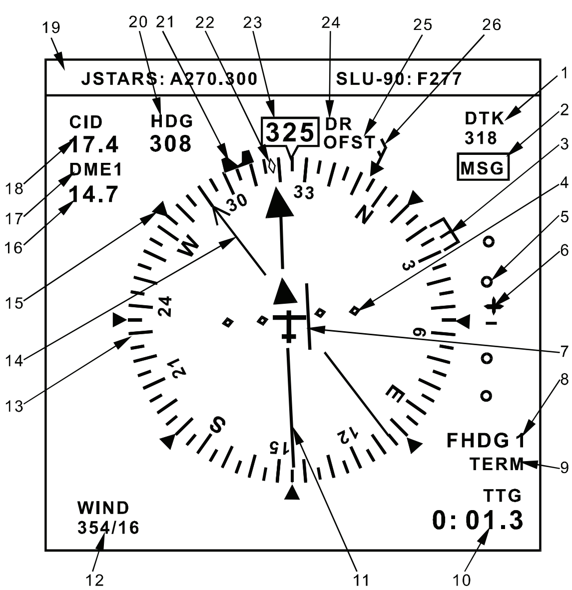


Figure 3B-55. HSI Display

Table 3B-41. HSI Display

NO.	DESCRIPTION/FUNCTION
1	Course Readout/Label
2	FMS Message Alert
3	FMS Heading Bug
4	Course Deviation Scale
5	Vertical Deviation Scale
6	Vertical Deviation Pointer
7	Lateral Deviation Bar
8	Course Source
9	FMS Flight Modes
10	Selectable Navigation Data
11	Course Pointer
12	Wind Direction (Deg)/Velocity (Knots)
13	Compass Rose
14	Bearing Pointer
15	Compass Benchmark
16	Distance of Bearing Source
17	Bearing Source
18	Distance to Course Source
19	Free Format Line (ARC-210 Freq)
20	Digital HDG Bug Readout
21	Heading Bug
22	Track Indicator
23	Digital Heading Readout
24	DR or RAM Alert
25	FMS OFST
26	Wind Pointer

The course/desired track readout and pointer on the EHSI show the great circle desired track at current aircraft position along the active leg. This may differ from the CRS display on the CDU Flight Plan page when the distance to the waypoint is large, especially at high latitudes. The CRS display on the Flight Plan page always references the inbound track measured at the waypoint. Refer to Figure 3B-56.

When the inbound course to the active waypoint is manually entered on the Flight Plan page, the course display and course pointer on the HSI show the desired course at the waypoint.

The scaling of the lateral deviation display on the HSI is determined by the selected FMS flight guidance mode selected on the Navigation Configuration page, Paragraph 3B-19.e.(6)(d) as follows:

1. *En route*. ± 4.0 nautical miles full-scale (2 dots) linear deviation.

2. *Oceanic*. ± 4.0 nautical miles full-scale (2 dots) linear deviation.

3. *Terminal*. ± 1.0 nautical miles full-scale linear deviation.

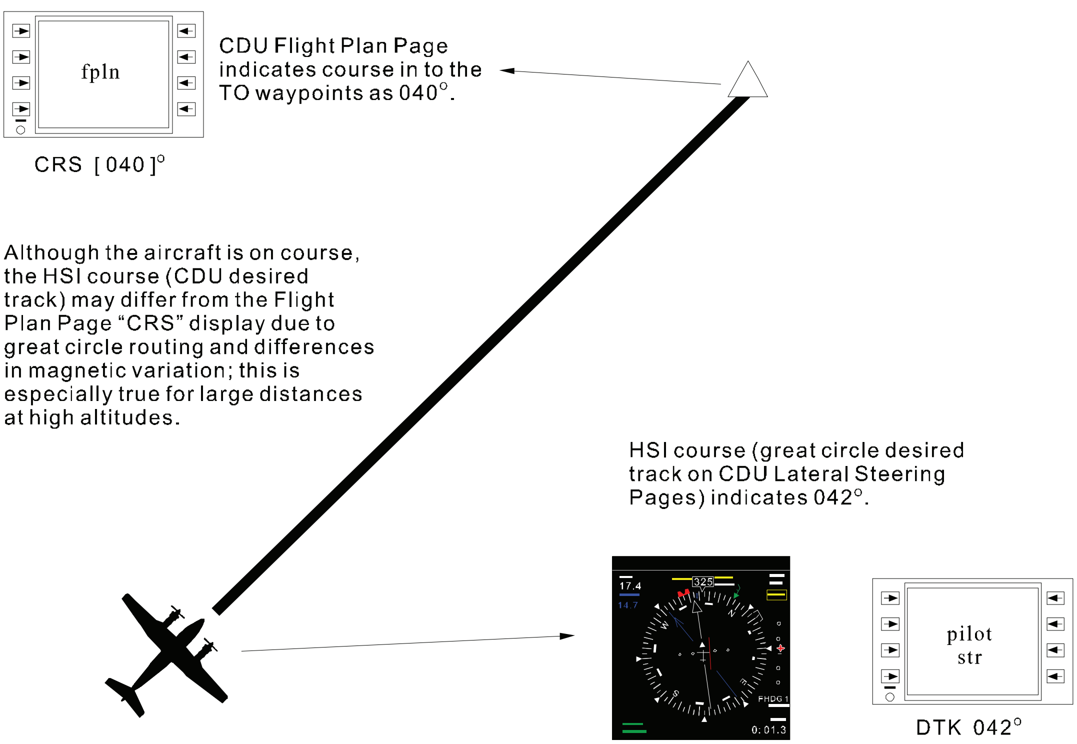
4. *Approach*. ± 0.3 nautical miles full-scale linear deviation.

The scaling of the vertical deviation display on the HSI is also determined by the current flight mode.

5. *Oceanic, En route, or Terminal*. ± 1000 feet full-scale deflection.

6. *Approach*. ± 300 feet full-scale deflection.

If no flight plan active waypoint is present and the navigation solution is valid, the HSI display will be blank removing current guidance information. If the navigation solution is invalid, the navigation source indicator will be red. If the navigation solution is valid but performance is degraded, the navigation source indicator will be yellow.



NOTE
Display values of course and desired track are shown for examples only.

Figure 3B-56. CDU Course Display and HSI Course (CDU Desired Track) Display

(3) Flight Director and Autopilot Lateral (Bank) Steering. Using the Flight Director or autopilot, the FMS can steer the aircraft directly through all of the possible flight plan maneuvers including holding patterns, MFP's, SID's, STAR's, and FMS approaches. This interface also enables the FMS to limit the commanded bank angle to the value specified on the Navigation Configuration page.

The FMS provides a heading submode (FMS heading) that allows the crew to temporarily fly to selected headings while still using FMS waypoint navigation. For those aircraft equipped with Electronic Flight Instrument Systems (EFIS), select FMS heading mode by pressing the HDG knob and adjusting the knob to the desired heading. The FMS will provide commanded bank to the selected heading indefinitely or until the heading is adjusted in such a way as to re-intercept the previous course.

(a) Additional Displays on Electronic Flight Instrument Systems. For those aircraft which are equipped with an electronic flight display system (EFIS or FDS), additional displays may be provided as shown in Figure 3B-57. The following additional data is available for display from the FMS on the primary flight instruments:

1. Eight future flight play waypoints (including the active) to give advance notice of impending leg changes and relative distances to future waypoints when the electronic HSI is in MAP mode.

2. Identification of the type of waypoint (i.e., NAV aid, intercept, standard waypoint, airport, etc.) and label identifier.

3. Ground speed.

4. True Airspeed.

5. Wind direction and speed.

6. Time to go.

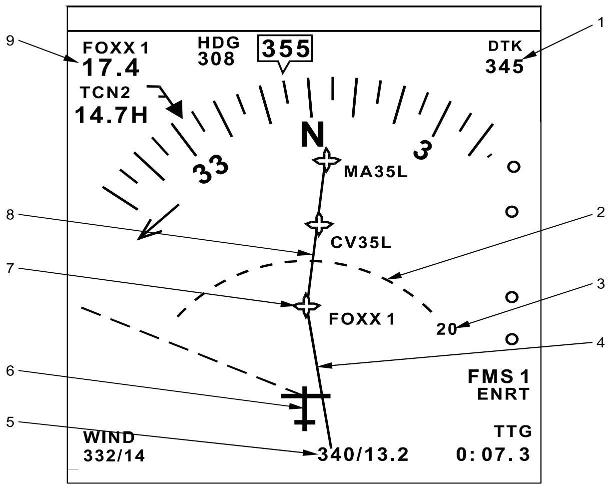
7. Bearing to Waypoint.

8. Elapsed Time.

(4) FMS Heading Mode Overview. The FMS-800 provides heading guidance for radar vectoring to intercept a final approach course of a published GPS approach, without the pilot needing to deselect and reselect the flight control system NAV mode.

(a) Activation of FMS Heading Mode. When commencing a published GPS approach, if ATC gives instructions to follow radar vectors to intercept the final approach course, select **DIRECT TO** the FAF. The message FINAL CRS XXX° will appear in the CDU scratchpad. Select line key L1 on the CDU to insert that final approach course extension as the currently displayed FMS course. Press the **HDG** knob on the FDS control panel to activate the FMS Heading Mode, and select the desired heading to intercept the final approach course. The FMS roll command will guide the aircraft to acquire and hold the displayed heading and any subsequent desired heading entered by the pilot on the FDS control panel. The FMS Heading Mode will continue to guide to the FDS selected heading as long as the heading is steering away from the flight plan course. When the selected heading is steering towards the flight plan course, the FMS Heading Mode will automatically cease when the course can be captured by normal FMS lateral guidance.

(b) Termination of FMS Heading Mode. With no further action on the part of the pilot, the FMS will automatically drop the FMS Heading mode and recapture the final approach course when the final course is intercepted, without overshoot. To manually terminate the FMS Heading mode, select **DIRECT / TO** the FAF or any other waypoint. The FMS will immediately resume FMS course guidance.



1. Course Readout
2. Range Scale Arc
3. Distance
4. Active Flight Plan Leg
5. Course Bearing/Range Readout
6. Aircraft Symbol
7. Waypoint Symbol
8. Interconnecting Track Lines
9. Distance Display

Figure 3B-57. EHSI Map Mode Display

j. Alternate Flight Plan Overview. The alternate flight plan is a complete plan for a mission or a mission segment that includes a route of up to 60 waypoints, with calculations of courses, distance, time, gross weight, and fuel requirements including reserve allocations. It includes standard flight planning data and provides an electronic hard copy of the flight plan in the FMS-800 that may be modified at any time.

Forty alternate flight plans may be stored on the data cartridge from either a Mission Planning Ground Station (MPGS) or laptop facility, or by manual entry via the CDU on the aircraft. One alternate flight plan at a time may be selected and transferred into the CDU for viewing and the operations are described in this section. This alternate flight plan is separate from the active flight plan and does not sequence or change unless the crew modifies it. It can be transferred or added to the active flight plan, Paragraph 3B-19e, and the alternate flight plan will remain intact.

The alternate flight plans stored on the data cartridge are not automatically updated with new waypoint data whenever a new primary ICAO database is loaded onto an FMS data cartridge. With each ICAO database update, each alternate flight plan should be updated at a ground station (outdated waypoints replaced with current ICAO definition), and the on-aircraft FMS purged of existing flights plans. The updated alternate flight plans can then be used for normal operations.

(1) Alternate Flight Plan Structure. The alternate flight plan operates as a spreadsheet calculator. The crew inputs the flight plan routing, wind, and aircraft performance. The FMS-800 calculates the individual leg data as well as the flight totals. Vertical scrolling on the CDU accesses the legs of the plan (1 through 60). Complete data for each leg is accessed by lateral scrolling among leg pages with suffixes A, B, and C. Refer to Figure 3B-58 and Table 3B-42.

The Alternate Flight Plan Waypoints page presents the alternate flight plan in a format similar to the active flight plan, Figure 3B-26. Modify the alternate flight plan on this page in the same manner as the active flight plan.

(2) Alternate Flight Plan Access and Transfer. On the Alternate Flight Plan page, various top-level access and transfer options are offered to the crew. Refer to Figure 3B-59 and Table 3B-43. When an alternate flight plan is transferred or added to the active flight plan, only the sequence of waypoints and the following waypoint attributes are transferred: All others are calculated by the FMS-800 using sensed data rather than the planned parameters of the alternate flight plan.

1. Wind for each leg.
2. Altitude for each waypoint (if assigned).
3. The time associated with the last entered time of arrival.
4. MFP for each waypoint (if assigned).

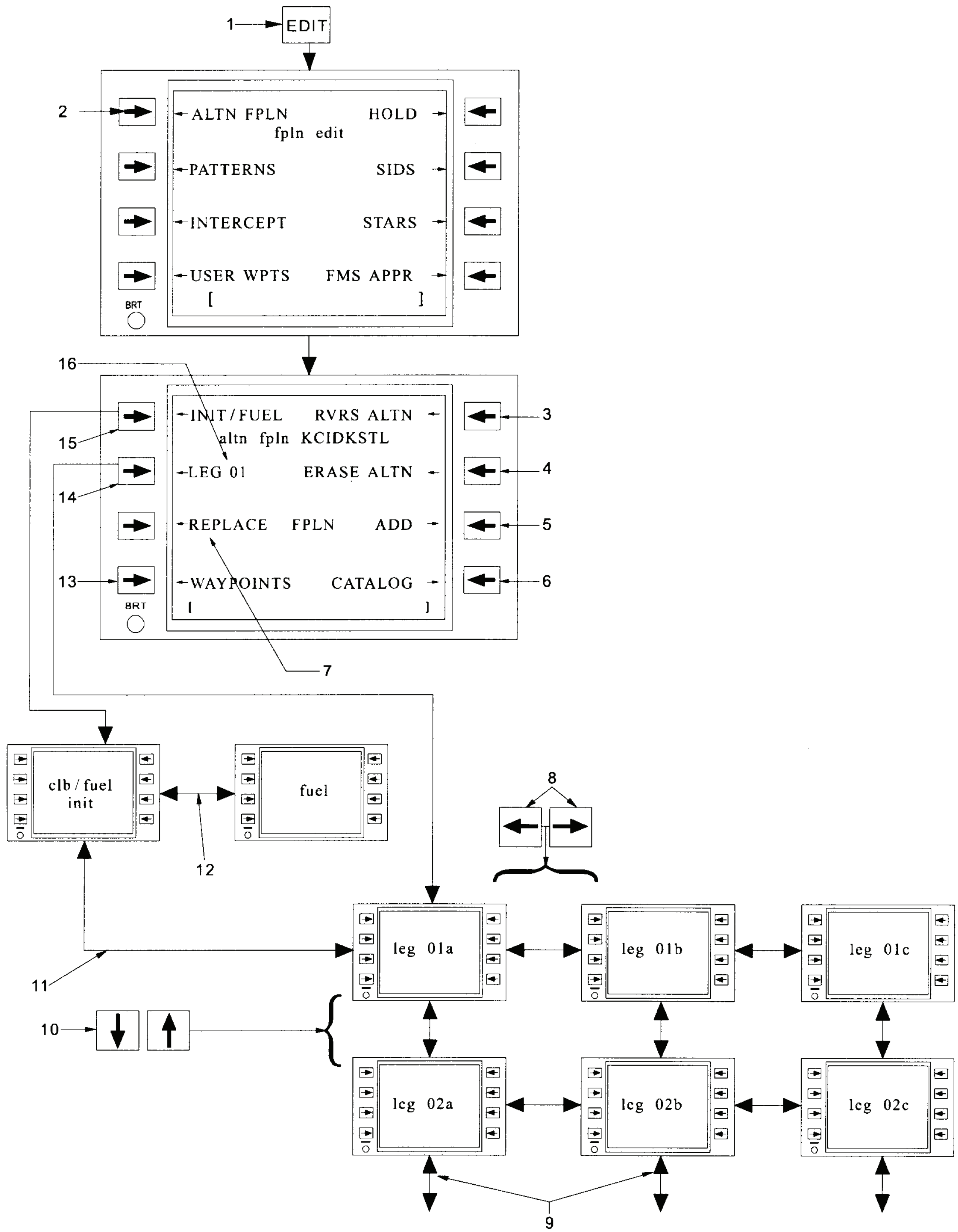


Figure 3B-58. Alternate Flight Plan Structure

Table 3B-42. Alternate Flight Plan Structure

NO.	DESCRIPTION/FUNCTION	NO.	DESCRIPTION/FUNCTION
1	Pressing **EDIT** function key to access edit page.	9	For vertical strolling to additional Leg pages.
2	Selecting **ALTN FPLN** select key.	10	Scroll vertically among the Leg pages in sequence.
3	To reverse the alternate flight plan waypoint sequence.	11	Scroll vertically between the Leg 01A page and the Climb Init page.
4	To erase the alternate flight plan.	12	Scroll laterally between the Fuel Init page, Fuel summary page, and the Climb Init page.
5	To add alternate flight plan at desired location in active flight plan.	13	To select listing of alternate flight plan waypoints.
6	To select catalog of available alternate flight plans on data cartridges.	14	To access Leg pages.
7	To replace active flight plan with alternate flight plan.	15	To access Init page.
8	Scroll laterally among the Leg pages for each leg.	16	Leg number corresponds to the last viewed Leg page; pressing this line select key will re-access the Leg page.

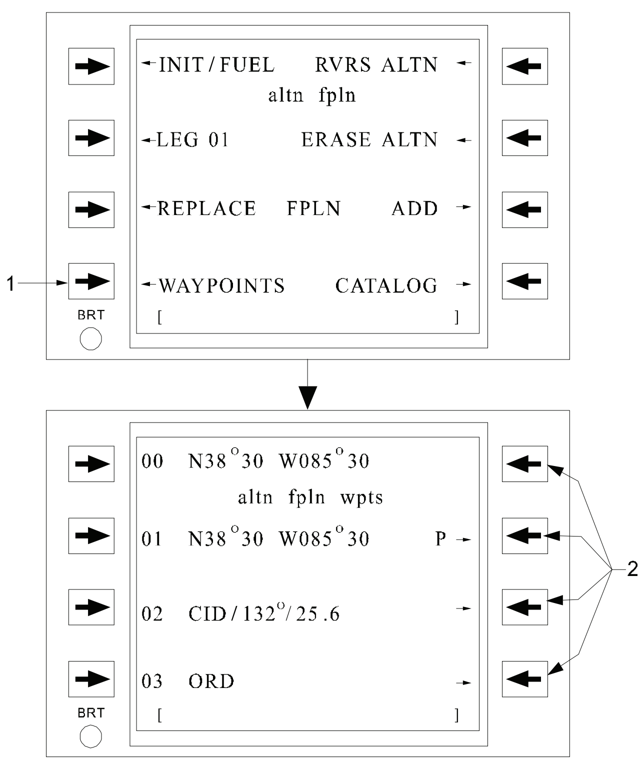


Figure 3B-59. Alternate Flight Plan Waypoints Page Access

Table 3B-43. Alternate Flight Plan Waypoints Page Access

NO.	DESCRIPTION/FUNCTION
1	Press to access the Alternate Flight Plan Waypoints page.
2	Waypoints reviewed and entered as on the Flight Plan page.

(3) Alternate Flight Plan Initial Time, Fuel, And Weight. The alternate flight plan initial time, fuel, and weight entries are optional. If the alternate flight plan is added to an existing flight plan, the crew cannot include climb parameters. Refer to Figure 3B-60 and Table 3B-44.

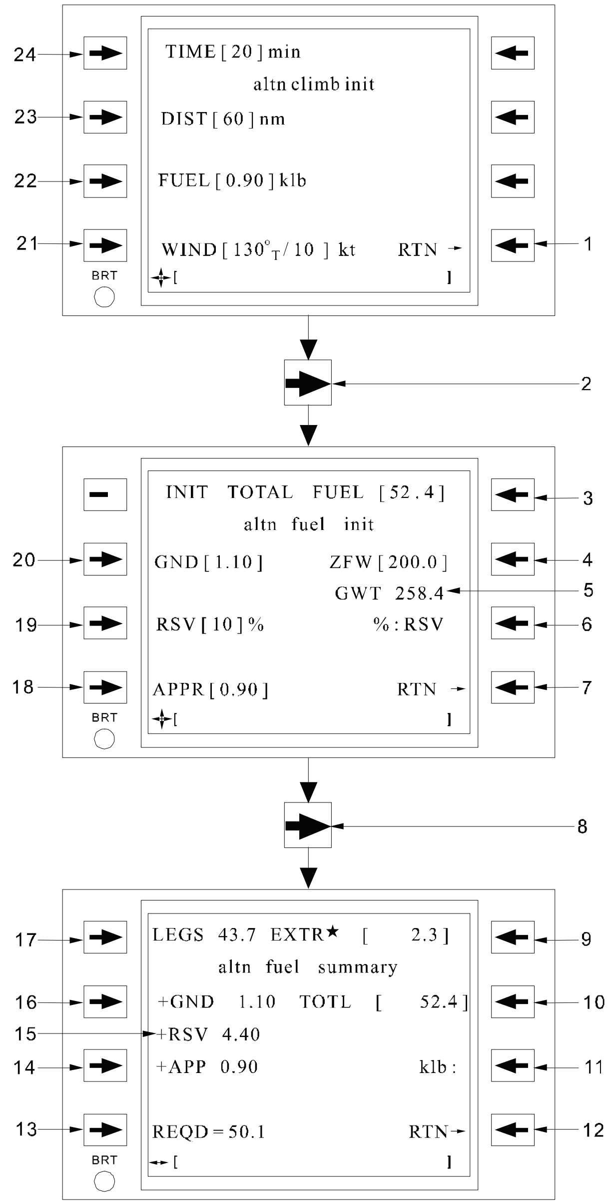


Figure 3B-60. Alternate Flight Plan Init and Fuel Pages

Table 3B-44. Alternate Flight Plan Init and Fuel Pages

NO.	DESCRIPTION/FUNCTION
1	Return to Alternate Flight Plan page.
2	Scroll laterally to access the Fuel Init page.
3	Insert initial fuel load.
4	Insert zero fuel weight.
5	Calculated gross weight.
6	Select desired reserve fuel calculation: klb, 0/0, or min.
7	Return to Alternate Flight Plan page.
8	Scroll laterally to access the Fuel Summary page.

Table 3B-44. Alternate Flight Plan Init and Fuel Pages (Continued)

NO.	DESCRIPTION/FUNCTION
9	Insert/display extra fuel (an asterisk indicates that the value was entered).
10	Insert/display initial ramp fuel (an asterisk indicates that the value was entered.)
11	Select the summary display between hours (hrs) and weight in thousands of pounds (klb).
12	Return to alternate Flight Plan page.
13	Total mission fuel required.
14	Approach fuel (entered on Fuel Init page)..
15	Reserve fuel (entered on Fuel Init page).
16	Ground fuel (entered on Fuel Init page).
17	Sum of all leg fuels.
18	Enter the approach fuel allowance.
19	Enter the reserve fuel with type of reserve selected at line select 3R.
20	Enter ground fuel allowance.
21	Insert average climb wind.
22	Insert climb fuel.
23	Insert zero wind climb distance.
24	Insert time to climb in minutes.

When the climb parameters are entered on the Alternate Climb Init page, the FMS calculates a Top Of Climb (TOC) leg segment that is used for fuel calculations. The TOC is displayed on the Alternate Flight Plan Leg A page for the leg that contains the TOC. Refer to Figure 3B-61 and Table 3B-45. All leg segments previous to the TOC use the climb leg calculations for fuel burn. Following the TOC, the fuel burn rates for each leg are used for fuel usage calculations.

The initial fuels entered on the Alternate Fuel Init page is used in the total fuel summary for the currently defined alternate flight plan. Initial total fuel is entered when the quantity of fuel loaded is currently known or planned. If desired, this value can remain blank and the FMS will calculate a total fuel summary that must be entered prior to departure on the Fuel Summary page.

Reserve fuel can be entered as either a percentage of mission fuel (%), specified weight (klb), or duration (min) using the fuel burn rate of the last leg of the alternate flight plan.

The ground and approach fuel allowances are calculated in the total fuel summary as indicated on the Fuel Summary page.

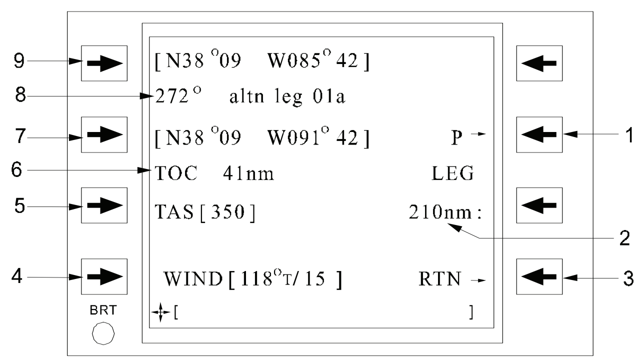


Figure 3B-61. Alternate Flight Plan Leg A Page

Table 3B-45. Alternate Flight Plan Leg A Page

NO.	DESCRIPTION/FUNCTION
1	The P indicates pattern attached; pressing this line select key will access the associated pattern Definition page.
2	Leg distance or distance to waypoint/ remaining.
3	Return to Alternate Flight Plan page.
4	Insert leg wind (– resets to blank; no defined wind).

Table 3B-45. Alternate Flight Plan Leg A Page (Continued)

NO.	DESCRIPTION/FUNCTION
5	Insert leg TAS (– resets to previous leg).
6	Top Of Climb (TOC) location within current leg.
7	Insert leg TO waypoint.
8	Outbound bearing of FROM / TO waypoint.
9	Insert leg FROM waypoint (leg 01 only).

The zero fuel weight entry is used to calculate the gross weight of the aircraft on the ground with fuel loaded and the gross weight remaining after each leg is flown as indicated on the Alternate Flight Plan B page. Refer to Figure 3B-62 and Table 3B-46.

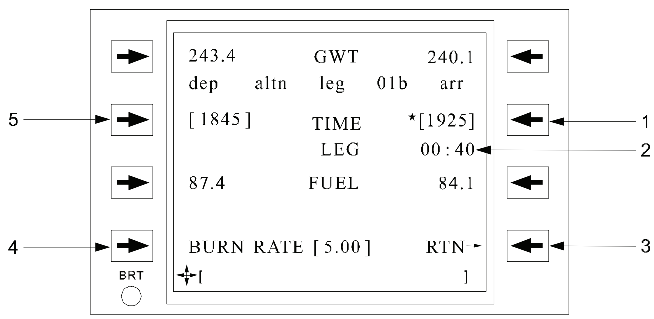


Figure 3B-62. Alternate Flight Plan Leg B Page

Table 3B-46. Alternate Fligh Plan Leg B Page

NO.	DESCRIPTION/FUNCTION
1	Insert planned time of arrival (* indicates quantity has been inserted; all other times calculated from entered time).
2	Leg Estimated Time En Route (ETE).
3	Return to Alternate Flight Plan page.
4	Insert leg fuel burn rate.
5	Insert planned time of departure (first leg only).

(4) *Alternate Flight Plan Fuel Summary*. The Fuel page presents a summary of the fuel requirements for the alternate flight plan. Refer back to Figure 3B-60. If no approach (APPR) fuel is entered, no approach time is allocated. If an approach fuel is entered, a standard 15-minute time allotment is added to the total flight time, regardless of the amount of fuel entered. If an initial total fuel has been entered on the Fuel Init page, the EXTRA fuel is calculated by subtracting the required (REQ) from the TOTAL. If an EXTRA value is entered (in hours or kilo-pounds), the required initial total fuel is calculated and shown as the TOTAL. If an aerial refueling (ONLOAD) is entered at a waypoint in the alternate flight plan, an EXTRA entry is not permitted. With an ONLOAD fuel defined, the initial total fuel is not automatically computed (fixed entry), and EXTRA fuel is calculated from the initial total fuel, ONLOAD fuel, fuel required, and total fuel entered. The display of total and extra fuel summary can be selected between total fuel quantity (klb) and duration (hr).

(5) *Entry and Display of Alternate Flight Plan Legs*. Unless entered by the crew, the default starting point for the first leg is the current aircraft position from the Start 1 page at the time a new plan is created. Waypoints may be inserted and deleted on the Leg A pages or on the Alternate Flight Plan Waypoints page, in the same manner as for the active flight plan.

The bearing displayed on the Leg A page is the outbound bearing from the starting waypoint for that leg.

The Top Of Climb (TOC) readout appears on the leg with the distance into that leg that the TOC is planned to occur, given the average climb wind and performance data entered on the Climb Initialization page.

Selecting line select 3R toggles between distance from the origin of the Alternate Flight Plan (AFP) to the current waypoint/distance from the current waypoint to the end of the AFP, or total leg distance for the current displayed leg.

If time and /or fuel calculations are desired, enter the True Airspeed (TAS) and forecast wind at the cruising altitude on this page. A TAS or wind entry on this page will transmit from the current displayed waypoint to all succeeding waypoints when entered. Insertion of a new waypoint will use the previous leg's wind and TAS entries. A blank wind will default to no wind when in the alternate flight plan. Refer to Paragraph 3B-19e(6)(b) for a description of waypoint wind usage in flight planning.

Patterns (MFP's) may also be inserted or attached to waypoints in the alternate flight plan. When inserted or attached, a P is indicated on the right side of line 3 and this also allows direct access to that pattern's definition page for review or modification.

(6) *Entry and Display of Alternate Flight Plan Leg Time, Fuel, And Weight*. Scrolling laterally from the Leg A page to the Leg B page, the pilot may enter parameters to compute the time, fuel, and gross weights for each leg.

The waypoint departure and arrival times for each leg, shows elapsed time from takeoff (i.e., assume a default takeoff time of 00:00). If a required departure or waypoint arrival time is entered then the times are fixed times with respect to the entered value. The alternate flight plan ETA's are calculated to each waypoint using the waypoint wind and TAS entries provided for each waypoint on the leg A pages.

Only one required time may be entered in the alternate flight plan, either the first departure time or any waypoint arrival time. The ***** indicates an entered required time versus a computed departure or arrival time. If a loiter/hold/pattern on-station elapsed time is entered on the Leg C page, the arrival and departure times for a waypoint will differ by that planned loiter time. If a fuel onload or cargo offload is entered at a waypoint, the arrival and departure fuel and/or gross weight will differ by the entered amount. Refer to Figure 3B-63 and Table 3B-47.

(7) Entry and Display of Planned Altitude. On the Leg C page optional entries of the planned cruise altitude/flight level and bank command limit for each leg may be made. Each altitude/flight level entry is transferred to the active flight plan when the alternate flight plan is transferred.

(8) Entry and Display of On-Station Loiter Time and Fuel Parameters. If the mission includes an aerial refueling pattern, holding pattern, MFP, or other loiter on-station at a waypoint, enter the planned loiter time and fuel burn rate on the Leg C page. This will cause the total mission time and fuel calculations to accommodate the planned loiter. If an intermediate landing without refueling is planned, enter the ground time with no fuel burn (or use another alternate flight plan for the next segment).

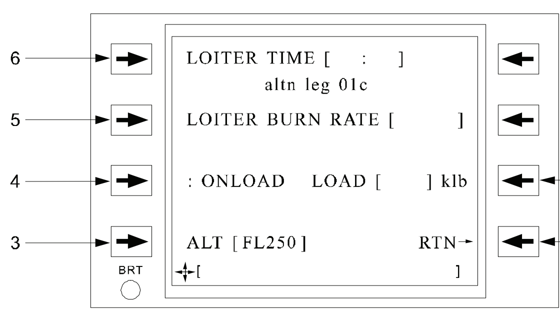


Figure 3B-63. Alternate Flight Plan Leg C Page

Table 3B-47. Alternate Flight Plan Leg C Page

NO.	DESCRIPTION/FUNCTION
1	Enter the ONLOAD or OFFLOAD weight.
2	Return to Alternate Flight Plan page.
3	Insert planned cruise leg or waypoint crossing altitude/flight level.
4	Select planned aerial refueling ONLOAD or cargo/deliver OFFLOAD.
5	Insert planned loiter fuel burn rate.
6	Insert planned on-station loiter time.

(9) Entry and Display of Fuel/Weight ONLOAD / OFFLOAD. If an aerial refueling/cargo delivery is planned during the flight plan leg, perform the following:

1. Select **ONLOAD** or **OFFLOAD** at line select 3L for the waypoint where the delivery is to occur, Figure 3B-63.

2. Enter the ONLOAD / OFFLOAD quantity in the scratchpad.

3. Select and press the **LOAD** line select key.

If an ONLOAD is entered, the FMS-800 assumes that the loaded quantity is usable fuel and increments both the departure gross weight and fuel remaining at that waypoint. In this case, the REQD and TOTAL (mission) fuel on the Fuel Summary page will be greater than the initial ramp fuel loaded on the Init Fuel page.

If an offload is entered, the FMS-800 assumes that it is either an airdrop payload or a tanker aerial refueling offload; i.e., it will reduce the gross weight but not the usable fuel remaining at that waypoint.

(10) Alternate Flight Plan Loading To/From the Data Cartridge. The alternate flight plan may be transferred to or from one of forty alternate flight plan files located on the data cartridge. Paragraph 3B-19d describes the initial preflight loading of an alternate flight plan on the Start 3 page via either entering the plan number or label, or accessing the Alternate Flight Plan Catalog page.

To save an alternate flight plan that has been created or modified on a CDU to the data cartridge, access the Alternate Flight Plan Catalog page from the Alternate Flight Plan page. The line select keys on the Alternate Flight Plan Catalog page do not operate as they do when this page is accessed from the Start 3 page. Selecting a line select key on the Alternate

Flight Plan Catalog page when accessed from the Alternate Flight Plan page will access the Alternate Flight Plan Load/Save page. From this page, either load the alternate flight plan associated with the line select key pressed or enter a new label for the alternate flight plan and save it to the data cartridge. Refer to Figure 3B-64 and Table 3B-48 for the procedures/descriptions on how to use the Alternate Flight Plan Load/Save page.

When a save or load of an alternate flight plan is in progress, LOADNG ALTN or SAVING ALTN will display on the information line of the Alternate Flight Plan page, Alternate Flight Plan Catalog page, and the Alternate Flight Plan Load/Save page.

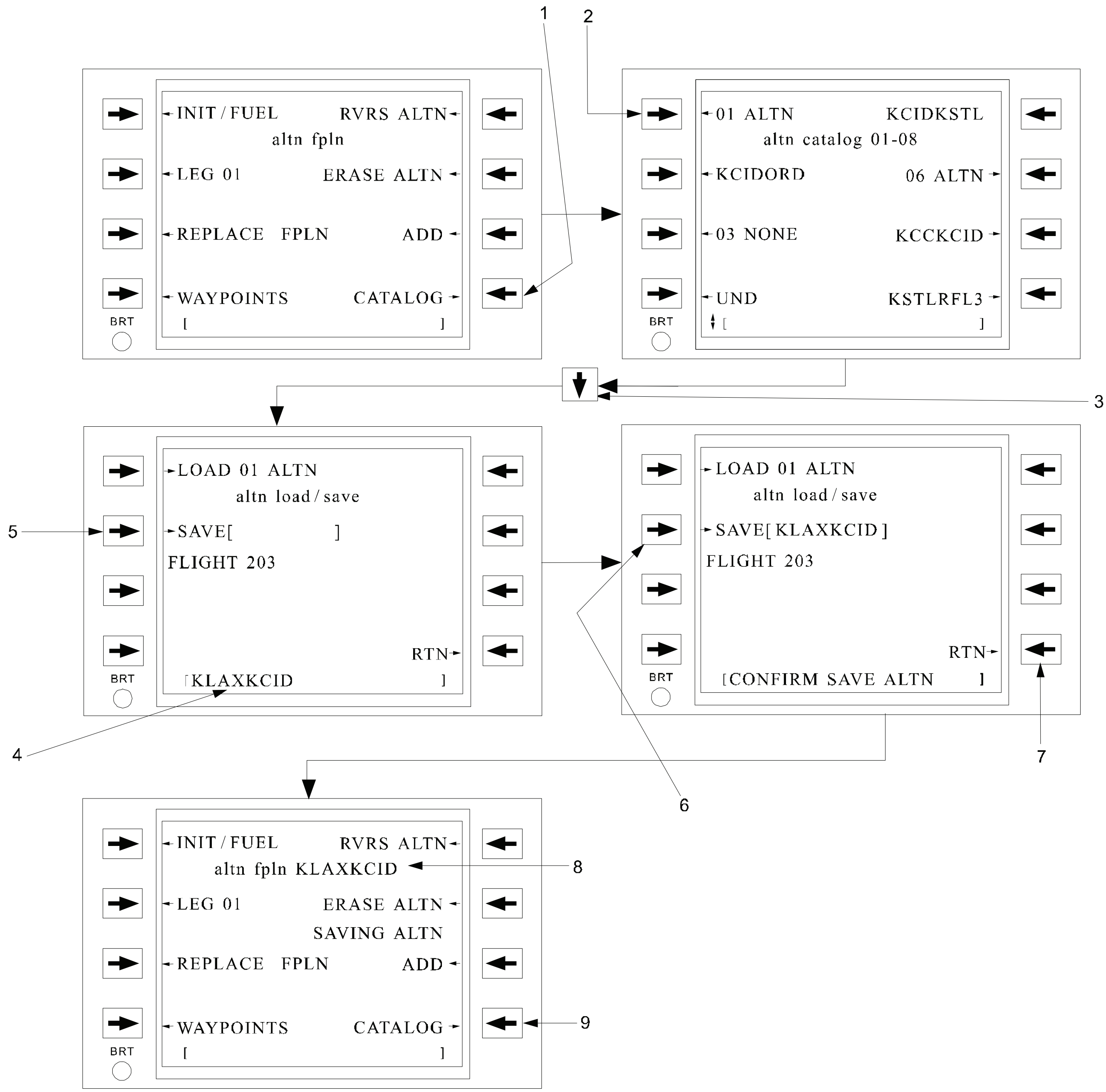


Figure 3B-64. Alternate Flight Plan Load/Save Page Access

Table 3B-48. Alternate Flight Plan Load/Save Page Access

NO.	DESCRIPTION/FUNCTION
1	Press line select key to access Catalog page.
2	Alternate flight plan 01 has been modified in this example; to save it to the cartridge, press the **01 ALTN** line select key.
3	Vertical scrolling will access additional Catalog pages.
4	Enter the new name in the scratchpad.
5	Select **SAVE**.
6	Press line select key to confirm the save.
7	Press line select key to return to the Alternate Flight Plan page.
8	Indicates the current loaded alternate flight plan.
9	Indicates the save/load is in progress.

k. Holding Patterns.

(1) Holding Pattern Overview. The FMS-800 holding pattern conforms to the Federal Aviation Administration (FAA) definition of RNAV and conventional holding pattern guidance, with standard (right hand) and non-standard (left-hand) holding patterns using approved entry flight procedures.

The FMS supports two types of holding pattern definitions as follows:

1. User-defined holding patterns attached to fix waypoints by the user.

2. Published holding patterns that are derived from published instrument approach charts.

A holding pattern may be associated with one fixed waypoint (the holding fix). When the aircraft crosses the holding fix, holding guidance is activated, suspending normal leg advance until the holding pattern is canceled. Three parameters define the holding pattern: inbound course, turn direction, and pattern length.

(2) Holding Pattern Entry Guidance. An advisory and steering guidance for the entry method is computer in accordance with standard FAA procedures. The geometry for a standard (clockwise) holding pattern is shown in Figure 3B-65. For left-hand turns, a mirror image of each entry procedure applies. This advisory is displayed on the Hold page. Refer to Figure 3B-65 and Table 3B-49.

Prior to entering the holding pattern, the entry advisory will show the expected entry based on the inbound course to the holding fix. When the aircraft passes the holding fix, the advisory will be updated to show the actual entry in progress based upon the aircraft track at the holding fix. Refer to Figures 3B-66, 3B-67, 3B-68, and 3B-69 for possible entries into the holding pattern.

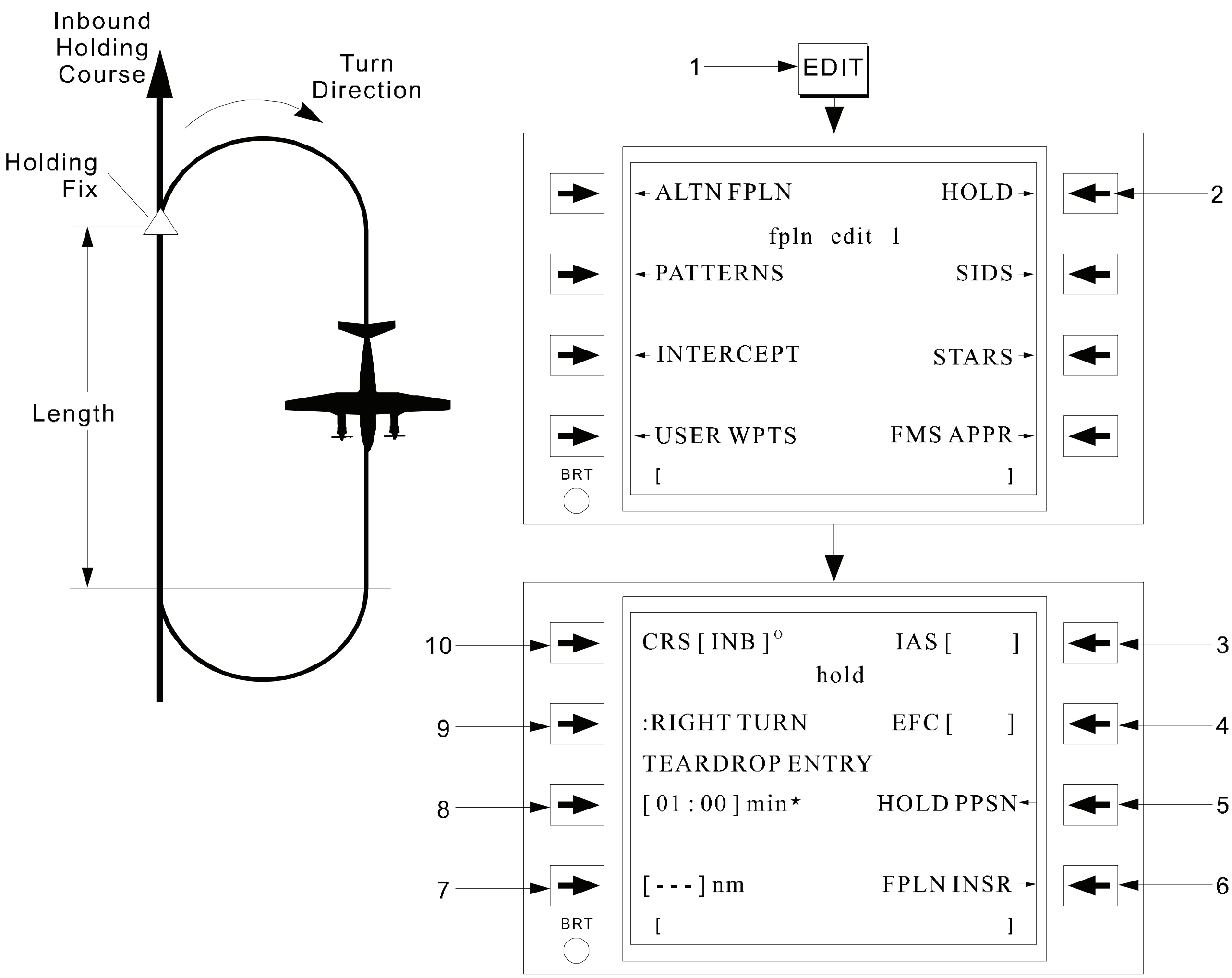


Figure 3B-65. User-Defined Holding Pattern Definition

Table 3B-49. User-Defined Holding Pattern Definition

NO.	DESCRIPTION/FUNCTION
1	Accesses the Edit page.
2	To select to the Hold page.
3	Enters the desired Indicated Airspeed (in knots) for the holding pattern.
4	Enters the Expect Further Clearance (EFC) time.
5	Executes the holding pattern at the present position.
6	Inserts the holding pattern into the flight plan or removes it.
7	Inserts the length of pattern's inbound leg. Defaults to 4 nm. If computer (not entered), it remains dashed until the hold pattern is active.
8	Enters the duration of the inbound leg (in minutes).
9	Selects between right and left turns in the pattern. Defaults to right turn.
10	Enters the course inbound to the holding fix (in degrees).

(3) Designation of the Holding Fix. After the user–defined holding pattern definition parameters have been entered, the active waypoint or a future fixed waypoint may be designated as the holding fix. After pressing the FPLN INS line select key on the Hold page, the Flight Plan page is accessed with the message ATTACH HOLD AT? in the scratchpad. Scroll the flight plan to the desired location. Press the adjacent line select key to identify the associated waypoint as the holding fix. An H is displayed to the right of the designated waypoint as a reminder that is has been designated as the holding fix. Refer to Figure 3B-70 and Table 3B-50.

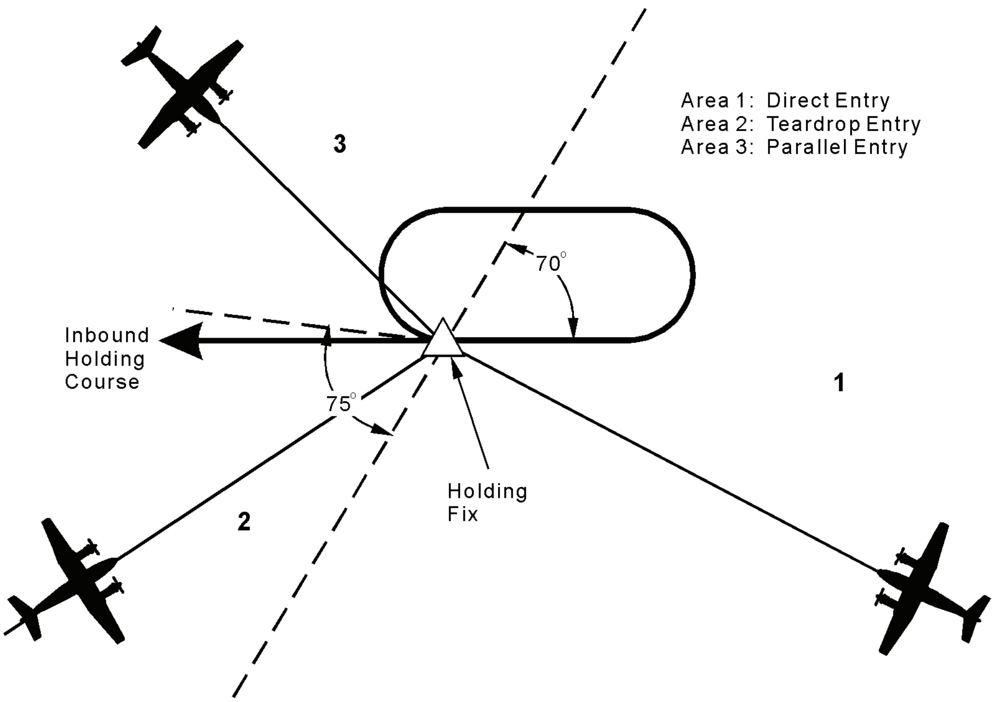


Figure 3B-66. Required Entry Methods

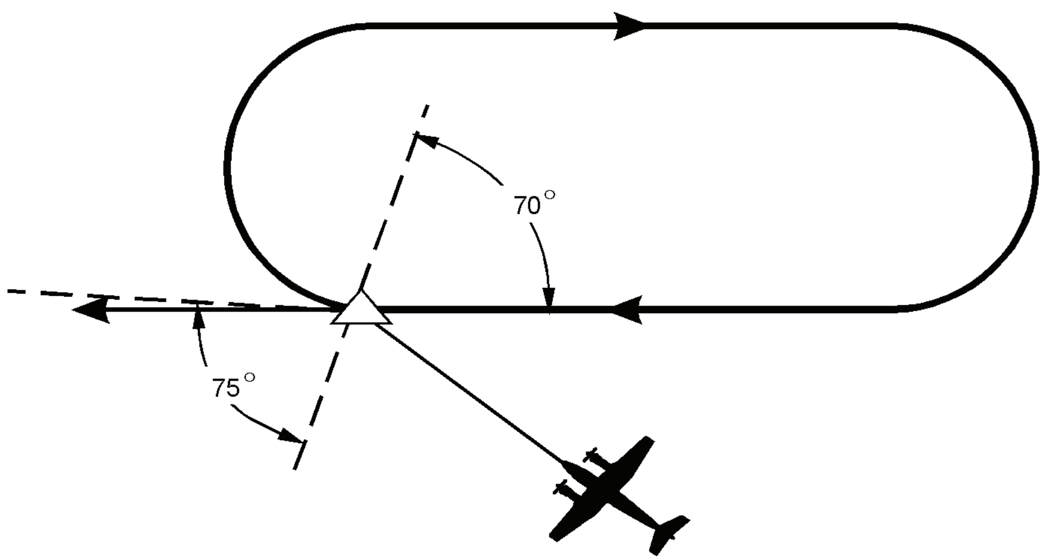


Figure 3B-67. Direct Entry Into a Holding Pattern

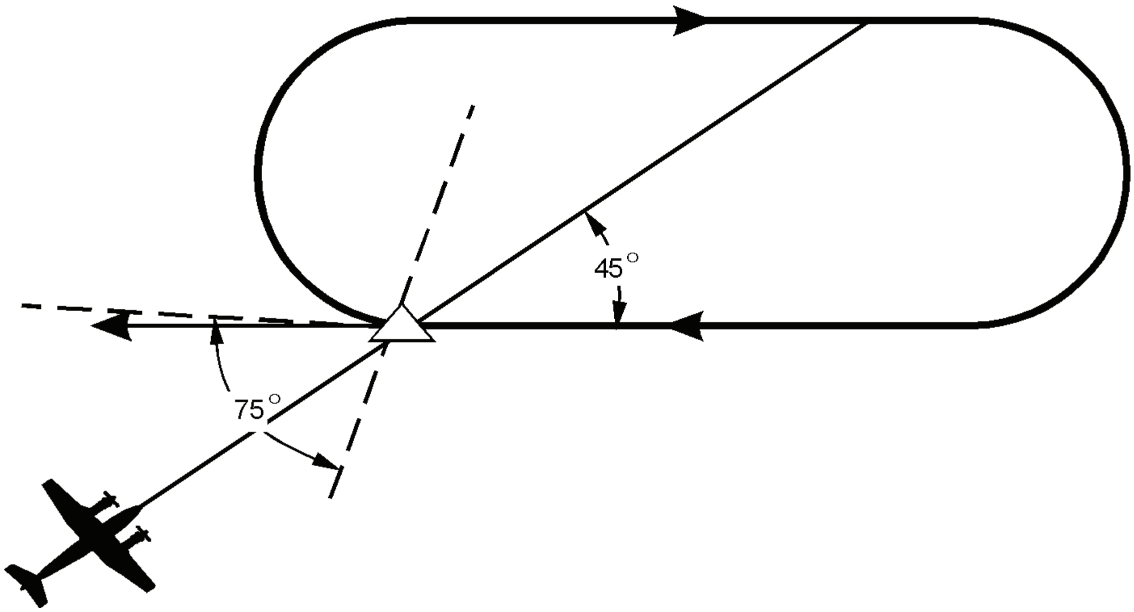


Figure 3B-68. Teardrop Entry Into a Holding Pattern

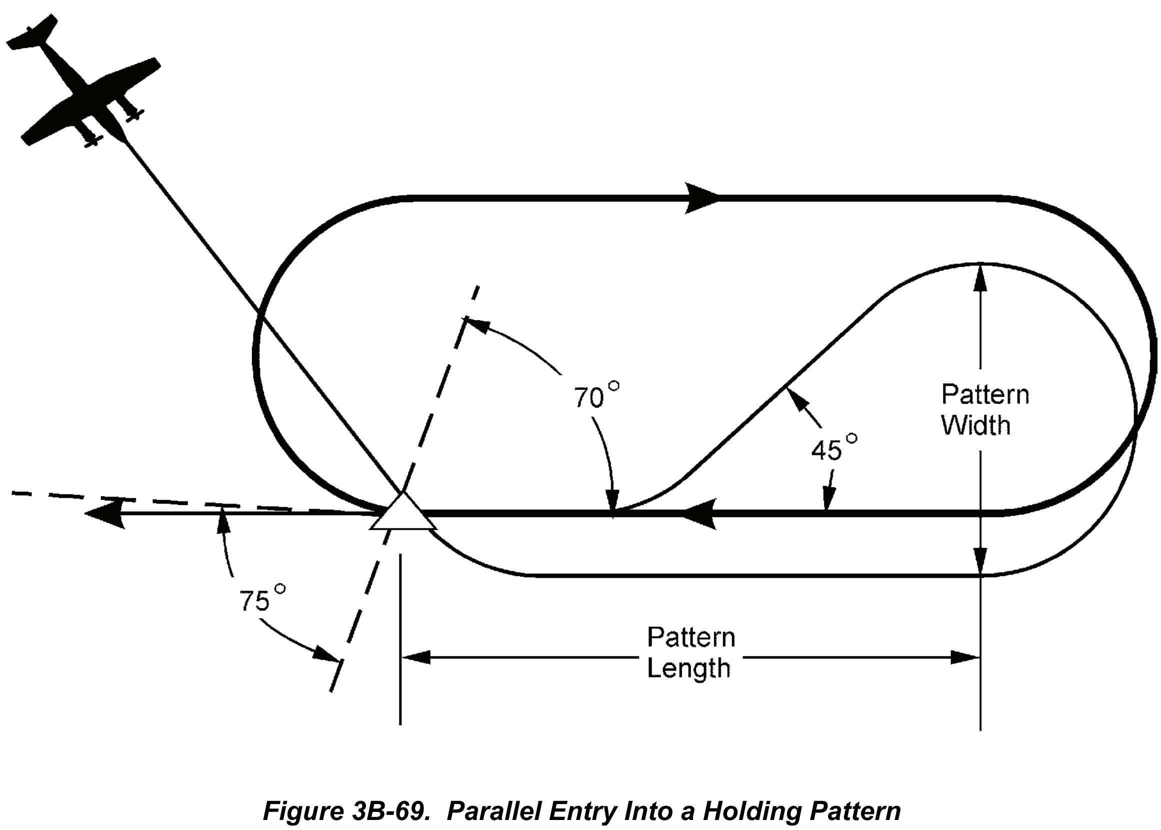


Figure 3B-69. Parallel Entry Into a Holding Pattern

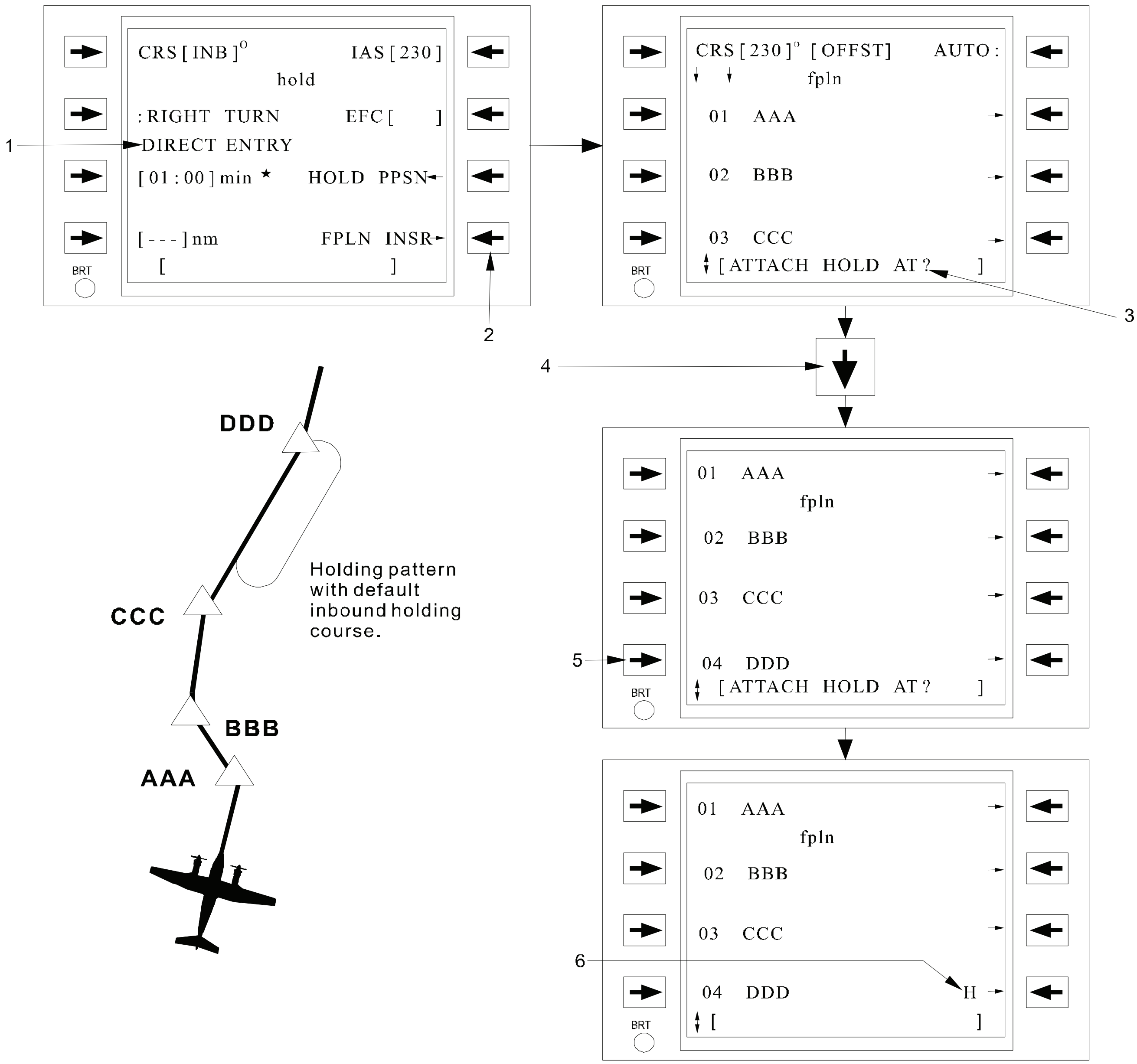


Figure 3B-70. Designation of Holding Fix

Table 3B-50. Designation of Holding Fix

NO.	DESCRIPTION/FUNCTION
1	Indicates pattern entry advisory on Hold page.
2	Press the **FPLN INSR** line select key to access Flight Plan page.
3	ATTACH HOLD AT? is in scratchpad.
4	Scroll to the desired waypoint.
5	Pressing line select key will identify the associated waypoint as the holding fix.
6	H indicates which flight plan waypoint has been designated as the holding fix.

(4) Immediate Present Position Hold. If it becomes necessary to hold the present position, access the Hold page. Press the **HOLD PPSN** line select key and confirm the selection by pressing it again. Refer to Figure 3B-71 and Table 3B-51. The aircraft present position is immediately inserted into the flight plan as the active waypoint, interrupting the current flight plan leg, and activates a holding pattern at that fix, with either the entered or default parameters on the Hold page. This pattern and its holding fix are treated the same as a preplanned hold at a flight plan waypoint. All parameters may be edited. Any user–defined holding patterns defined at future waypoints, will be deleted when a present position hold is activated.

(5) Holding Course Edits. If no holding pattern inbound course has been inserted, the inbound course to the fix is used when holding guidance is activated. If an inbound course has been inserted, the inbound holding course is fixed but may be edited.

The holding course is entered by two different methods. Default to the current inbound course to the fix, or enter the desired course by the crew via the scratchpad. In either method the course can be modified as needed.

To restore the inbound course to the fix waypoint as the holding course, enter a **–** and select the **CRS** line select key.

(6) Holding Pattern Length. The length of the holding pattern can be defined by either defining an inbound leg length or inbound leg duration. Before execution of the pattern, only the entered value will be displayed for the hold definition and will be identified with an *****. After the aircraft passes the holding fix, the FMS will calculate the length or duration that was not entered based upon the current groundspeed at the pattern fix. Default values for pattern length are 4.0 nm or 1 minute duration.

(7) Holding Pattern Activation and Execution. When the holding fix is passed for the first time the holding guidance computations are activated. At this time, the following changes will take place in the flight plan operation and page displays.

(a) The automatic leg advance is suspended.

(b) Course edits on the Flight Plan page may no longer be made. Inbound holding course edits may be made on the Hold page.

(c) All displays reference the inbound course displayed on the Hold page.

(d) Holding fix cannot be edited.

To edit a user-defined holding pattern once it is in the flight plan, press the line select key on the Flight Plan Waypoint page adjacent to the H attribute or use the **EDIT** key and select **HOLD**.

If the inbound course is changed, the FMS–800 commands an immediate turn to the current inbound course and upon passing the holding fix, performs a holding pattern entry procedure. If the direction is changed, the action commanded is similar to a course change. The FMS–800 commands an immediate turn to the inbound leg and upon passing the holding fix, turns onto the outbound leg in the new turn direction. If the leg length is changed, it will take effect immediately. The effect will depend on the position of the aircraft in the holding pattern at the time the length was changed. If the aircraft is outbound, the FMS–800 will command an immediate turn or maintain course depending on whether the new turning point is behind or in front of the aircraft, respectively. If the aircraft is in a turn, it will continue the turn and intercept the leg based on the old length. Upon completion of the turn, the new length will be active. The length and width of the holding pattern is recomputed, using the inbound groundspeed, each time the aircraft passes the holding fix.

When the holding guidance has been activated, all course and lateral deviation displays will reference the inbound holding course. The inbound holding course is referenced whether the aircraft is on the inbound or outbound leg of the holding pattern. The 10-second turn alert will be computed on the outbound leg to alert the crew of the upcoming turn to the inbound leg.

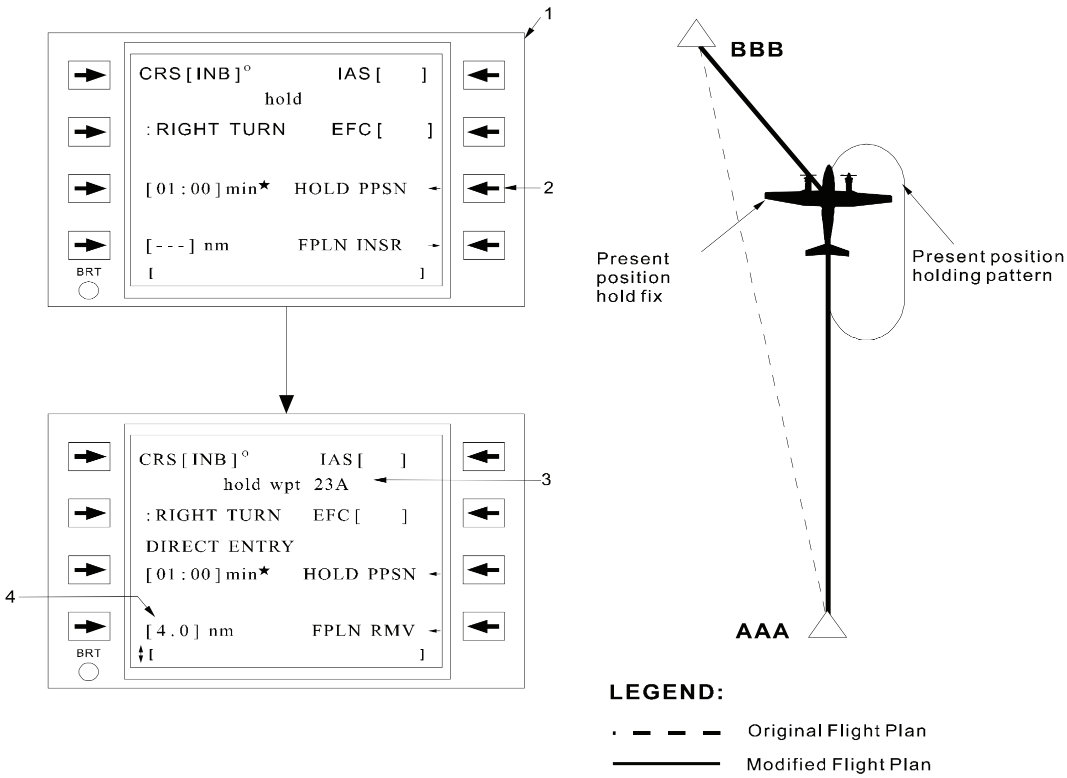


Figure 3B-71. Holding Present Position

Table 3B-51. Holding Present Position

NO.	DESCRIPTION/FUNCTION
1	Access the Hold page.
2	Press the **HOLD PPSN** line select key to perform a hold at present position and press twice to confirm selection.
3	Present position hold fix is inserted in flight plan (example: as waypoint 23A); inbound course is set to flight plan course to the fix.
4	When the hold becomes active, the computed value will appear.

(8) Holding Speed and Expected Further Clearance Time. The commanded holding speed and Expected Further Clearance (EFC) time entries and displays assist the pilot in executing a holding pattern in accordance with FAA air traffic control procedures. This also permits future waypoint ETA's to be more realistically calculated.

(a) Entry and Display of Holding Speed. Enter a desired holding speed at the Indicated Air Speed (IAS) line select, Figure 3B-72 and Table 3B-52. When the IAS defaults to blanks, the operator must enter a desired holding speed to enable the speed alert function during the holding patterns. Three minutes prior to arrival at the holding fix, the holding speed becomes the commanded speed reference on the Lateral Steering pages, for the ADI fast/slow indicator (if available) and for the speed threshold alert function. Upon exiting the holding pattern the speed command function reverts to its normal mode.

(b) Entry and Display of Expected Further Clearance (EFC) Time. The Hold page allows an optional entry of the ATC EFC or planned departure time from the holding fix. This permits a more realistic future waypoint ETA's. If an EFC is entered (in Coordinated Universal Time), then all future waypoint ETA's are calculated from that holding fix departure reference. If no EFC is entered or it is deleted, all future ETA's are calculated as if no loiter time will be spent in the holding pattern.

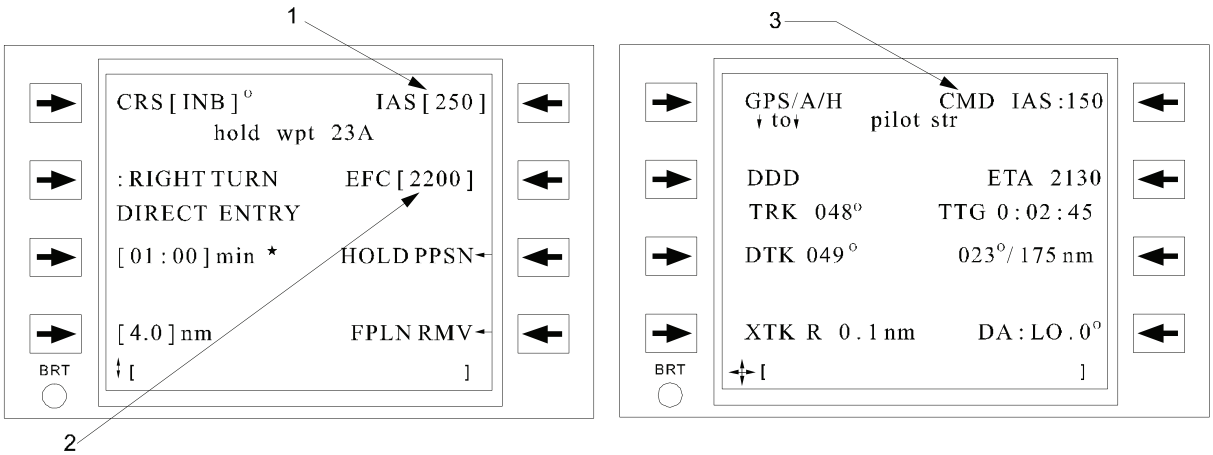


Figure 3B-72. Holding Airspeed and EFC Time Entry and Display

Table 3B-52. Holding Airspeed and EFC Time Entry and Display

NO.	DESCRIPTION/FUNCTION
1	The desired holding speed inserted.
2	EFC time inserted.
3	The CMD IAS holding speed appears on the Lateral Steering pages 3 minutes prior to arrival at holding fix.

(9) Exiting the Holding Pattern. Holding patterns may be terminated in the following two ways.

(a) By Cancellation. To cancel a holding pattern, delete "–" the pattern attribute next to the waypoint on the Flight Plan page. A leg switch to the next flight plan waypoint will occur when the fix is crossed again (if automatic flight plan advancing is selected). The hold data is defaulted after sequencing and the hold attribute is removed from the waypoint.

(b) Direct-To Another Waypoint Other Than the Holding Fix. This removes the holding pattern definition from the fix waypoint and resets the holding pattern parameters to default conditions.

(10) Published Holding Patterns. A published GPS approach in the flight plan may include several holding pattern definitions as part of the procedure. Published holding patterns are enabled on the Holding Pattern page for the holding fix waypoint. To review the holding pattern definition, select the right line select key adjacent to the IAF or Missed Approach Holding Point (MAHP) to access the Flight Plan Waypoint page for that waypoint. Then, select the right line select key for the pattern attribute to access the holding pattern definition. The IAF and MAHP holding pattern definitions are derived from published procedures.

When an approach procedure is inserted into the flight plan, the holding patterns associated with the IAF are disabled and the holding pattern associated with the MAHP is automatically enabled. To enable an IAF or FAF holding pattern, access the respective Holding Pattern page and select the **ENBL HLD** line. Refer to Figure 3B-73 and Table 3B-53. To disable a published holding pattern, enter a – on the Flight Plan page and delete the H attribute. Unlike the user-defined holding pattern, disabling the published holding pattern does not delete the holding pattern definition from the waypoint, but only disables execution of the pattern at the holding fix. When the attribute is deleted, the FMS will conclude the holding pattern and immediately turn inbound to the holding fix while annunciating, "Exiting Hold."

The course, turn direction, and size of the published holding pattern are defined by the procedure, but may be modified as described in previous paragraphs for user-defined holding patterns. Entry and execution of the published holding pattern is identical to what is used for the user-defined holding patterns.

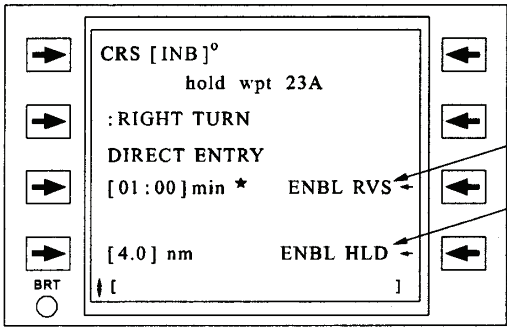


Figure 3B-73. Hold Page (Database Hold)

Table 3B-53. Hold Page (Database Hold)

NO.	DESCRIPTION/FUNCTION
1	Select to enable the Course Reversal Execution.
2	Select to enable the Holding Pattern execution.

I. SID's and STAR's.

(1) SID/STAR Overview. The FMS-800 enables the pilot to select, by name, a Standard Instrument Departure (SID) and/or a Standard Terminal Arrival Route (STAR) for insertion into the active flight plan only. When a SID or STAR is selected, the FMS-800 inserts all of the SID/STAR procedure waypoints in the correct sequence, along with any crossing altitude restrictions.

(2) SID/STAR Selection and Flight Plan Entry. To select a SID/STAR procedure for use in the active flight plan, press the **EDIT** key on the CDU and then select the SID or STAR line select to access the corresponding SID/STAR definition pages. Refer to Figure 3B-74 and Table 3B-54. To define a desired SID or STAR, enter the airport associated with the desired SID or STAR and select the ORIG or DEST line selects to access the possible procedures for the airport. Next, select the SID/STAR name and desired runway. Access the Transition Page and select a desired transition point (optional), and then insert the procedure into the active flight plan. When a transition point is not selected, the FMS will insert into the flight plan only the common leg segments for the procedure.

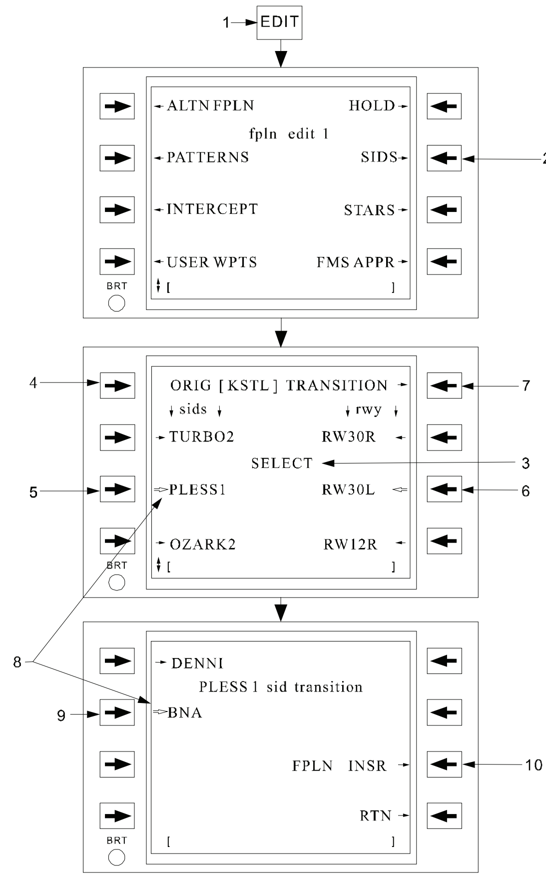


Figure 3B-74. Selecting SID/STAR

Table 3B-54. Selecting SID/STAR

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** Function Key for Edit page.
2	Select the SID or STAR definition.
3	Indicator shows no procedure currently in the active flight plan.
4	Enter the airport associated with the desired SID or STAR.
5	Select the desired SID or STAR.
6	Select the desired runway.
7	Press to access the Transition page.
8	Fat Arrows indicate current selection for insertion.
9	Select the desired transition point (optional).
10	Insert the procedure in the flight plan.

Two different SID/STAR's for an airport can be maintained by the FMS-800. One is inserted into the flight plan and the other is referred to as the working copy. The current SID/STAR definition being displayed is indicated by the data on the information line of the SID/STAR page and by asterisks and larger arrows displayed adjacent to the selected SID/STAR, runway and transition items. Large arrows indicate that the item has been selected for insertion into the flight plan (working copy). Asterisks indicate that the item is currently included in the active flight plan.

(3) The current definition of a SID or STAR procedure is accessed by selecting the SID S or STAR R attributes from the Flight Plan and Flight Plan Waypoint pages. Refer to Figure 3B-75 and Table 3B-55. The current definition can be removed or modified as needed.

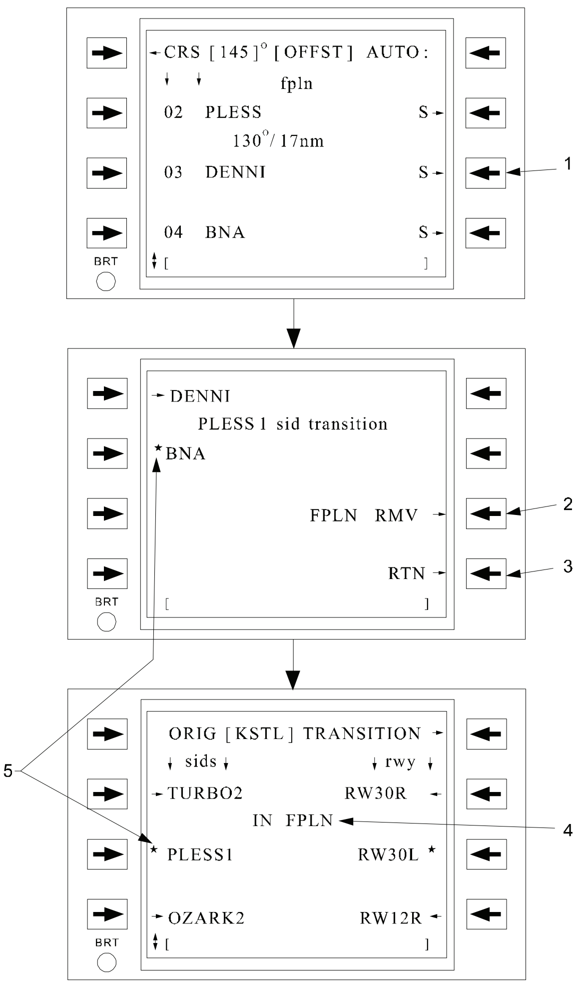


Figure 3B-75. Active Flight Plan SID/STAR Procedure

Table 3B-55. Active Flight Plan SID/STAR Procedure

NO.	DESCRIPTION/FUNCTION
1	Select the SID or STAR attribute on the Flight Plan page and Flight Plan Waypoint page to access the current procedure definition.
2	Select to remove the SID/STAR procedure from the active flight plan.
3	To Return to Flight Plan page.
4	Indicator shows that this definition is currently IN the flight plan.
5	Asterisks indicate current definition in the active flight plan.

(4) When modified, the modified procedure becomes the working copy definition for the SID/STAR. Modification of the SID/STAR definition on the SID/STAR pages does not affect the active flight plan procedure until the operator chooses to modify the flight plan with the new procedure. The working copy definition of a SID or STAR is accessed from the EDIT menu. Refer to Figure 3B-76 and Table 3B-56. When the working copy is defined, it can be used to modify the active flight plan procedure with the new definition.

If a SID is in the flight plan, the information line of the SID page displays IN FPLN and asterisks are shown next to the selected SID items. The working copy is displayed if the information line displays either SELECT or MODIFY and there are large arrows displayed next to the selected SID items. If SELECT is displayed, no SID is in the flight plan and if MODIFY is displayed, a SID is inserted in the flight plan but can be replaced with the new working definition.

The selection, removal, and flight plan operation of STAR's is identical to that of SID's. The exception is the STAR's are accessed using the STAR line key on FPLN EDIT 1 page and are displayed for the entered destination airport rather that the origin airport. The destination airport for a STAR and approach definitions is shared in the respective working copy definitions until either definition is entered into the active flight plan. SID's, STAR's, and approaches entered into the active flight plan maybe selected for different airports; for example, a STAR may be flown for one destination airport and an FMS approach maybe executed for another airport nearby. The STAR waypoints are indicated by an R attribute on the Flight Plan page instead of an S for a SID waypoint. As SID or STAR waypoints are passed into history, they loose their S or R attribute and become ordinary waypoints. To re-execute a SID/STAR procedure (once it passes into history), the entire procedure must be replaced into the flight plan.

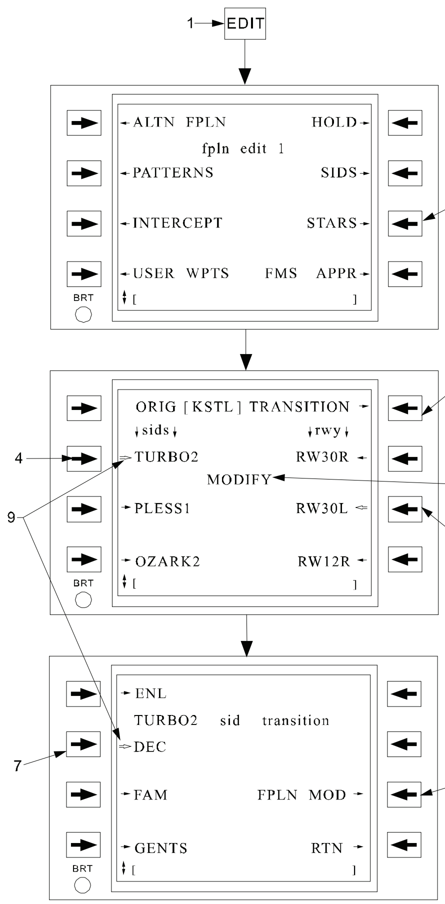


Figure 3B-76. Working Copy SID/STAR Procedure

Table 3B-56. Working Copy SID/STAR Procedure

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Select the Sid or STAR definition.
3	Indicator shows the definition is currently not in the flight plan, but the active flight plan SID/STAR procedure can be modified.
4	Select the desired SID or STAR.
5	Select the desired runway.
6	Press to access the Transition page.
7	Select the desired transition point (optional).
8	Select to modify the flight plan with the selected SID/STAR procedure. This selection will replace the current procedure in the active flight plan.
9	Fat arrows indicate current selection for insertion.

(5) Flight Plan Discontinuities. A discontinuity in the flight plan may occur when using SID/STAR's. A discontinuity is associated with a waypoint and requires crew action to resolve in order to obtain proper flight plan sequencing. The waypoint associated with the discontinuity can be either the one preceding, following, or both. A discontinuity is inserted into the flight plan under the following three conditions:

1. Following a STAR or preceding a SID when it is inserted in the flight plan (DISCONTINUITY).

2. When a leg of a SID/STAR has a non-flyable leg (LEG DISCON).

3. When a flyable leg of a SID/STAR has a turn direction associated with it (LEG DISCON).

Refer to Figure 3B-77 and Table 3B-57 for an example of the Flight Plan page with a discontinuity. The VERIFY PROC annunciation and CDU MSG alert are displayed when there is 1 minute to go before sequencing into the discontinuity. If the discontinuity becomes the active waypoint, a DISCONTINUITY annunciation is displayed.

The discontinuity is resolved by the following methods.

1. Delete the discontinuity.

2. Delete the waypoint the discontinuity is associated with.

3. Insert a waypoint between the discontinuity and the waypoint it is associated with.

4. Remove the SID/STAR from the flight plan (except if the discontinuity is the active waypoint).

5. Perform a direct-to while in the discontinuity.

When the discontinuity becomes active, guidance displays will be invalidated and the FMS will continue a wings-level flight until the pilot takes action to resolve the discontinuity.

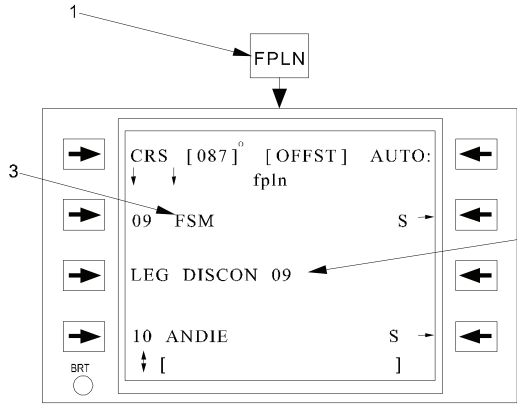


Figure 3B-77. Discontinuity in the Flight Plan

Table 3B-57. Discontinuity in the Flight Plan

NO.	FUNCTION/DESCRIPTION
1	Pressing **FPLN** function key for Flight Plan page.
2	The waypoint associated with the discontinuity.
3	The active waypoint.

m. FMS Approaches.

(1) FMS Approach Overview. The FMS approach function employs GPS navigation to fly the following types of approaches:

1. FAA published RNAV approaches.
2. FAA published RNAV, VOR, VOR/DME, VORTAC, and NDB approaches with GPS overlay approved procedures (GPS or INU/GPS only).
3. FAA published GPS approaches (GPS or INU/GPS only).
4. Military approved approach procedures for air bases in lieu of ILS or other approach guidance.
5. Visual runway approaches at night or in reduced visibility.
6. Military tactical approaches to forward air bases where the approach key points have been surveyed or marked using precise GPS.

(2) Selection of an FMS Approach. FMS approaches may be flown using the active flight plan guidance. They may not be inserted into an alternate flight plan.

(3) To select an FMS approach for use in the active flight plan, press the **EDIT** function key on the CDU and then select **FMS APPR** line key to access the FMS APPR selection page. Refer to Figure 3B-78 and Table 3B-58. Three types of FMS approaches may be selected: GPS, Visual, or Tactical. To select either a published GPS or runway visual approach enter the Destination (DEST) airport identifier at the top of the page (also entered on the working copy STAR definition). This calls up a listing of available GPS approaches and runways for that airport. To select a user defined tactical approach, no airport identifier is required, select the **TACTICAL** line key.

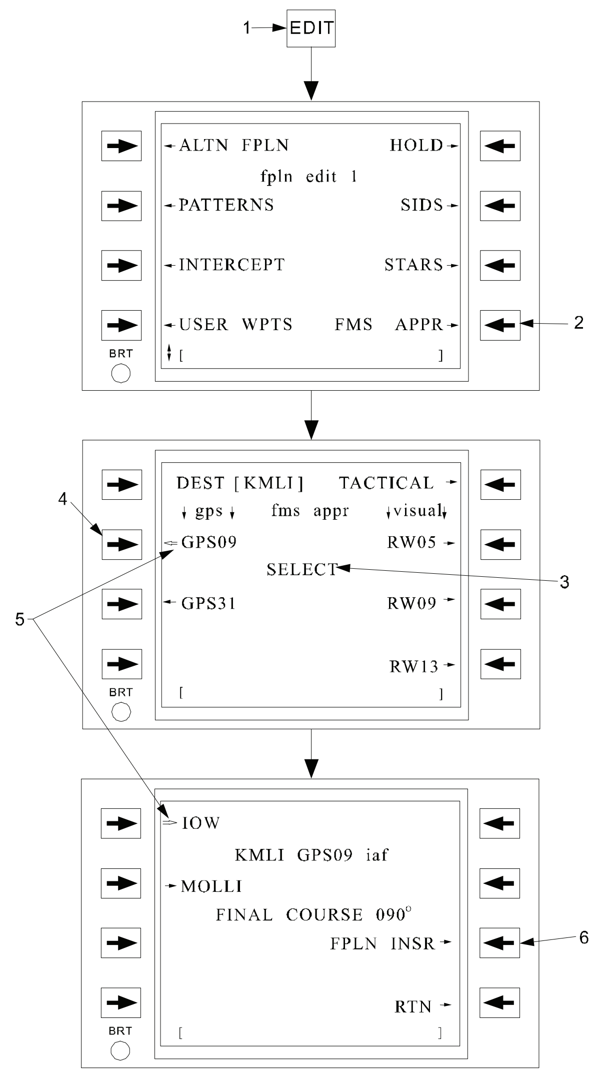


Figure 3B-78. Defining an Approach

Table 3B-58. Defining an Approach

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Press line select key to access the FMS approach page.
3	Indicator shows NO definition is currently in the active flight plan.
4	Press line select key to access GPS approach page.
5	Fat arrows indicate current selection for insertion.
6	To insert the approach into the flight plan press line select key.

Two different FMS approaches can be selected and maintained by the FMS-800. One is inserted into the active flight plan and the other is referred to as the working copy. The current approach definition being displayed is indicated by the data on the information line of the FMS Approach page and by asterisks and larger arrows displayed adjacent to the selected approach. Large arrows indicate that the item has been selected for insertion (working copy). Asterisks indicate that the item is currently included in the active flight plan.

(4) Selecting the approach MAP attribute from the Flight Plan and Flight Plan Waypoint pages, Figure 3B-79 and Table 3B-59, accesses the current definition of an approach procedure. The current definition can be removed or modified as needed. When modifying, the modified procedure becomes the working copy definition for the approach. Modification of the approach definition on the Approach pages do not affect the active flight plan approach until the operator chooses to modify the flight plan with a new procedure. The working copy definition of an approach is accessed from the Edit menu, Figure 3B-80 and Table 3B-60. When the working copy is defined, it can be used to modify the active flight plan approach procedure, replacing the existing procedure with the new definition.

Using the FMS approach function requires the system to insert a sequence of waypoints into the flight plan. All approaches will have a Final Approach Fix (FAF) or Runway Extension Point, and a Missed Approach Point (MAP). GPS approaches may also have a Missed Approach Holding Point (MAHP) and an Initial Approach Fix (IAF). These points are treated by the system as any other waypoint. The MSL altitudes may be entered for each point, with the exception of the MAP and visual approach's runway extension point. The altitudes and descent angles for a MAP are fixed definitions.

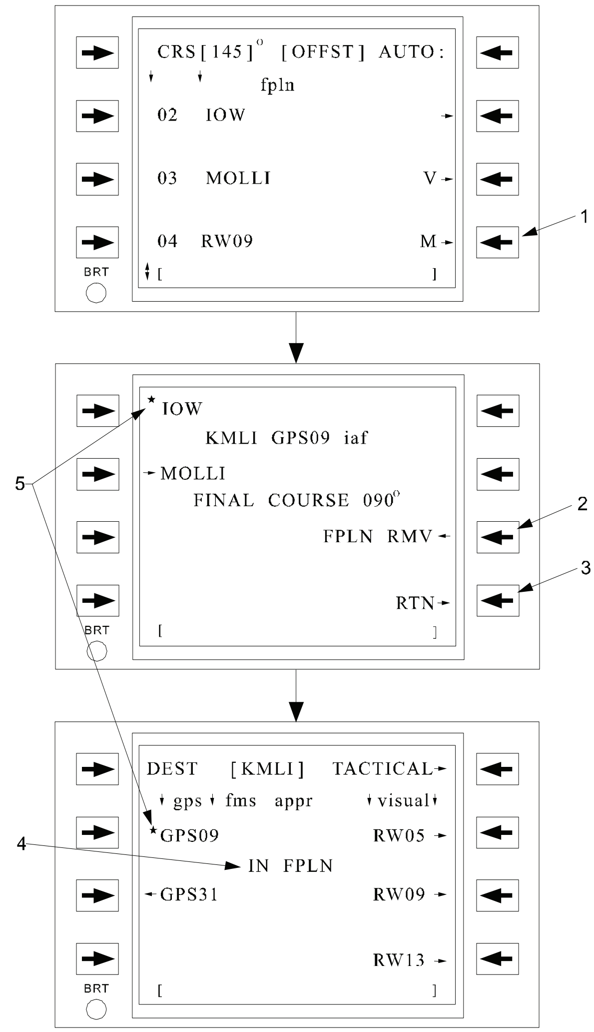


Figure 3B-79. Active Flight Plan Approach Definition

Table 3B-59. Active Flight Plan Approach Definition

NO.	DESCRIPTION/FUNCTION
1	Selecting MAP attribute on the Flight Plan page and Flight Plan Waypoint page will access the current approach definition.
2	Pressing line select key will remove the approach from the active flight plan.
3	Select line key will return to FMS approach page.
4	Indicator shows this definition is currently IN the Flight Plan.
5	* indicates that the current definition is in the flight plan.

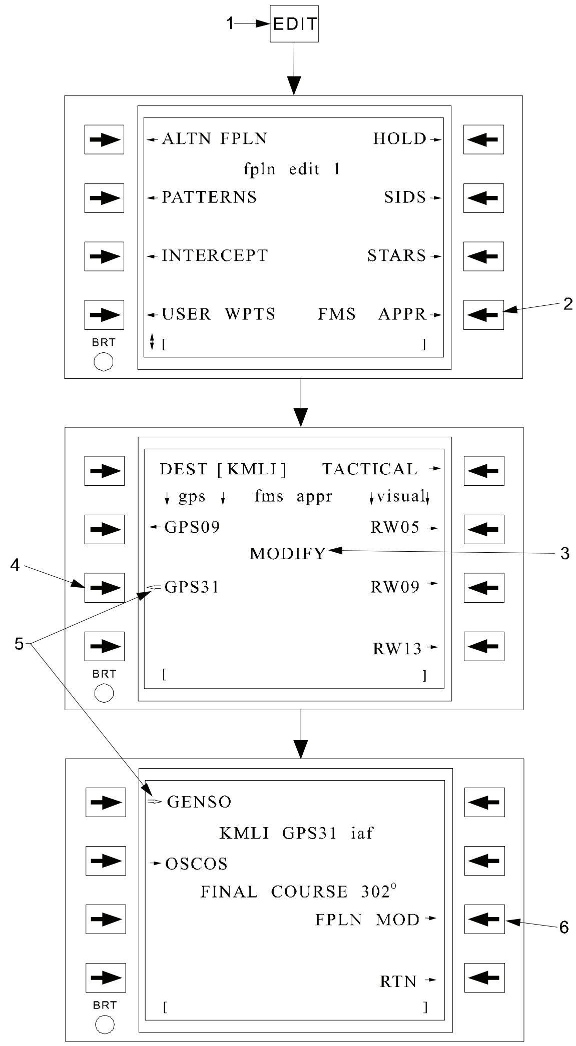


Figure 3B-80. Working Copy Approach Definition

Table 3B-60. Working Copy Approach Definition

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Press line select key to access the FMS approach page.
3	Indicator shows this definition is currently NOT IN the Flight Plan, but is available to modify the active Flight Plan approach procedure.
4	To select GPS approach page.
5	Fat arrows indicate current selection for insertion.
6	Select line key to modify the flight plan with the selected approach procedure. This selection will replace the current procedure in the active flight plan.

(5) Refer to Figure 3B-81 for definition and execution of a typical FMS approach as described in the following paragraphs.

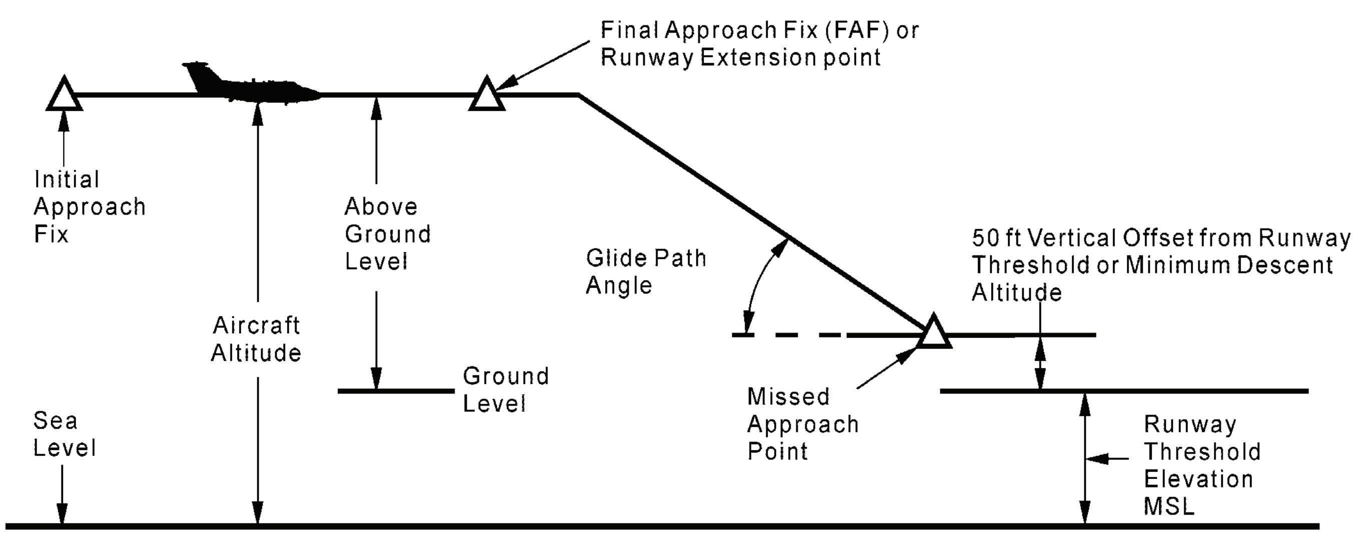


Figure 3B-81. Approach Execution

(6) GPS Approaches. After entering the destination airport identifier, selecting a published GPS approach will access the Initial Approach Fix (IAF) page, Figure 3B-82 and Table 3B-61. Select the desired IAF and press the **FPLN INSR** line key to call up the Flight Plan page. The INSRT G-APR BEFORE? scratchpad message will appear. Now select the point at which the approach is to be inserted in the flight plan.

After the approach is inserted, the Flight Plan page will show the published IAF, intermediate points, the Final Approach Fix (FAF), and the Missed Approach Point (MAP). The missed approach procedure points and Missed Approach Holding Points (MAHP) will also be shown. The MAP of a GPS approach is either at the runway threshold of the approach, or a MAP for a circling approach. Consult published procedures to determine correct operation for GPS approach into the MAP. If the missed approach point is not at the runway threshold (as in a circling approach), then the MAP altitude will be the Minimum Descent Altitude (MDA) published for that approach. For MDA approach altitudes, the descent angle into the MAP will be blanked on the Flight Plan Waypoint page for the MAP, and FMS vertical guidance will be disabled for the final approach into the MAP. The V attribute for vertical guidance definition will not be displayed on the Flight Plan page for MDA approaches. For MDA approach altitudes, select the MDA altitude on the autopilot altitude preselector to initiate guidance to the MDA approach. MAP's that do not terminate at the runway threshold are assigned identifiers other than the RWXX identifier.

There are no user–defined entries other than the airport identification, GPS runway selection, and the initial approach fix selection. On the IAF Select page, the approach can be inserted without selecting an IAF. The FMS will use the IAF at the top of the page as the default. Published GPS approaches that have been defined without identifiable IAF's have been filtered out of the FMS operation. The FMS does not recognize a GPS approach without an IAF.

The FMS supports three types of GPS approach procedures as follows:

1. GPS approaches with basic T configuration and point–to–point guidance.

2. GPS overlay approach with DME arc.

3. GPS overlay approach with course reversals/procedure turns.

Each approach is described in greater detail under GPS approach execution.

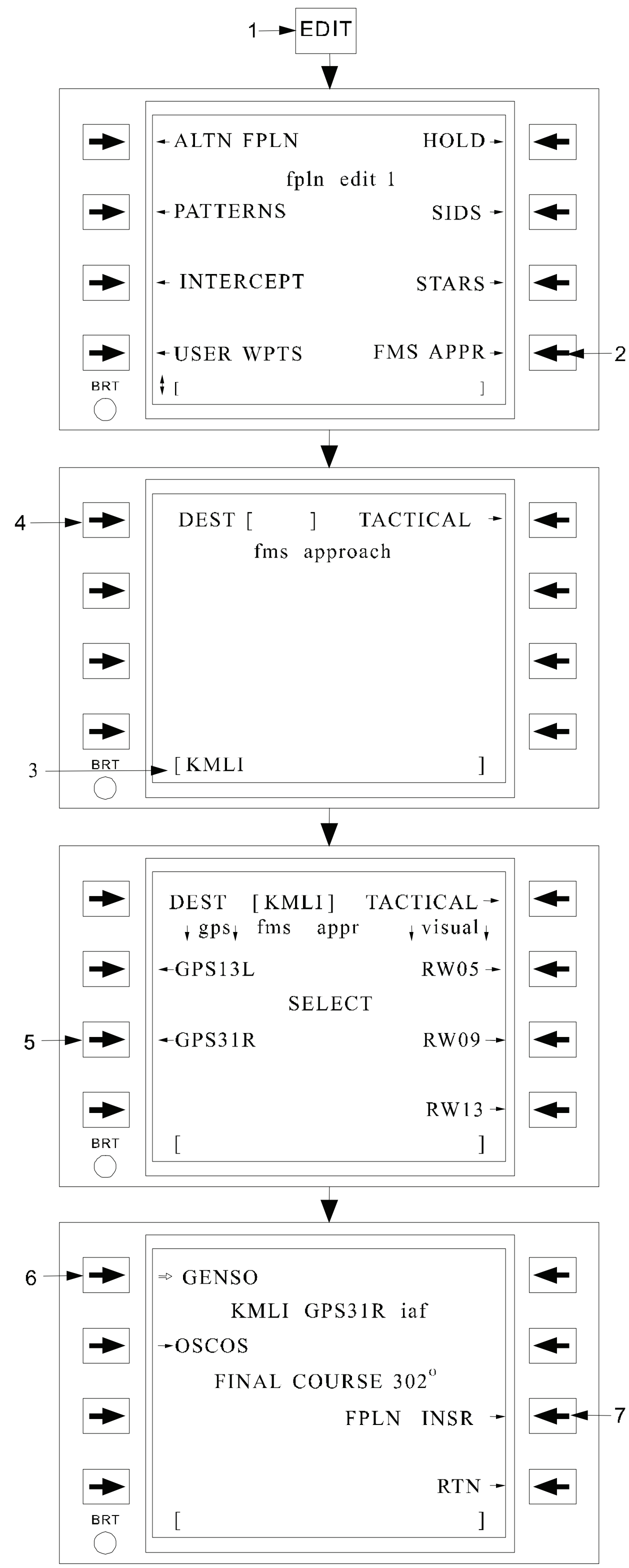


Figure 3B-82. Published GPS Approach Access

Table 3B-61. Published GPS Approach Access

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Press **FMS APPR** line select key for access to the FMS approach page
3	Enter the airport identifier into the scratchpad.
4	Insert destination airport identifier.
5	Select the desired GPS approach.
6	Select the Initial Approach Fix.
7	Insert the approach into the active flight plan.

(7) Visual Approaches. Selecting a runway (on the right side of the FMS Approach page) calls up the VISUAL runway approach page, Figure 3B-83 and Table 3B-62. The default visual approach parameters (can be modified, if desired) are a 5.0 nm final segment and a 3.0° glideslope, with a crossing altitude for the runway extension point of 1500 feet AGL. Press the **FPLN INSR** line key to insert the approach into the active flight plan at the desired location in the same manner as for the published GPS approach. The Flight Plan page will be displayed and the message, INSRT V-APR BEFORE? will appear in the scratchpad. Press the line select key next to the desired waypoint to insert the approach at that point. This action inserts a computed runway extension point (RXTND) and the selected runway threshold (RWY09) into the flight plan in sequence at the desired point.

Table 3B-62. Visual Approach Selection

NO.	DESCRIPTION/FUNCTION
1	Select visual approach data for desired runway.
2	Define the desired visual approach.
3	Enter the distance above the runway elevation for the runway extension point.
4	Enter runway extension point distance from runway.
5	Enter desired glideslope to runway.
6	Indicates elevation of runway from database.
7	Insert the approach into the flight plan.
8	Press the line select key to insert the approach.
9	Runway extension point (FAF equivalent).
10	Missed Approach Point or Runway Threshold.

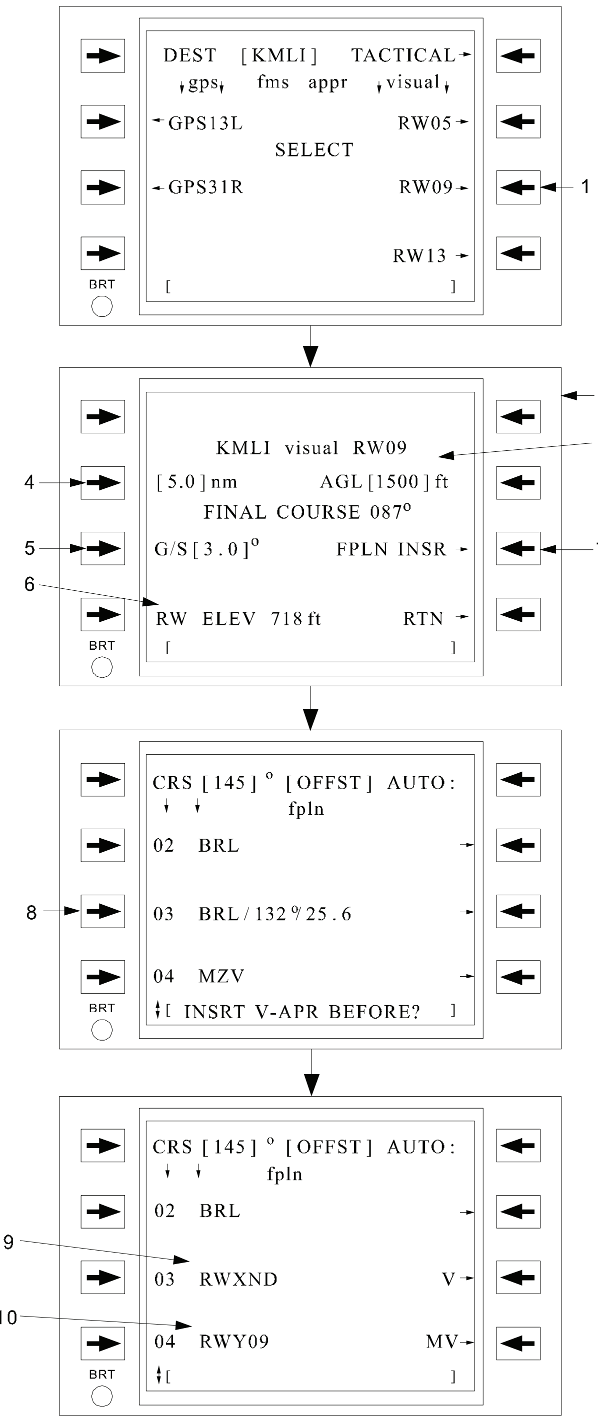


Figure 3B-83. Visual Approach Selection

(8) Tactical Approaches. Pressing the **TACTICAL** line select key will access the Tactical Approach page as shown in Figure 3B-84 and Table 3B-63. If required, modify the default tactical approach parameters and press the **FPLN INSR** line select key to insert the approach into the active flight plan.

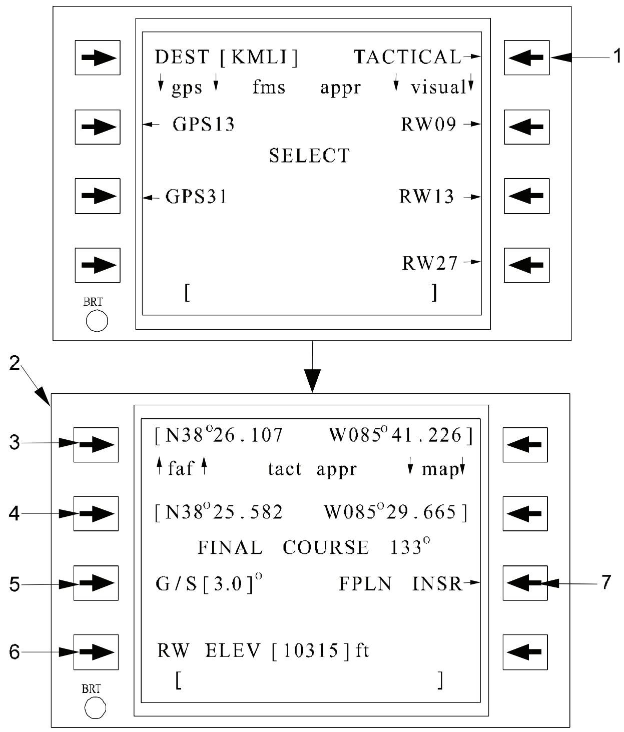


Figure 3B-84. Tactical Approach Selection

Table 3B-63. Tactical Approach Selection

NO.	DESCRIPTION/FUNCTION
1	Select the tactical approach page.
2	Define the approach as desired.
3	Enter a FAF.
4	Enter a MAP.
5	Enter the desired glideslope into the MAP.
6	Enter the Runway Elevation mean sea level for the MAP.
7	Insert the approach into the flight plan.

(a) To change the FAF displayed on line 1, type in a valid waypoint in the scratchpad and press line select key 1 or 5. To copy the waypoint displayed on line 1 into the scratchpad, press line select key 1 or 5 when the scratchpad is blank. To delete the waypoint indicated on line 1, enter a **–** in the scratchpad and press line select key 1 or 5.

(b) To change the MAP, type a valid waypoint in the scratchpad and press line select key 2 or 6. To copy the MAP into the scratchpad, press line select key 2 or 6 when the scratchpad is blank. To delete the MAP, enter an ***** in the scratchpad and press line select key 2 or 6.

(c) The default value defining the glideslope is 3.0 degrees and is automatically displayed at line select key 3 when the tactical approach page is displayed. To change this value, enter the desired value (0 to 6.0°) into the scratchpad and press the line select key 3. To change the runway elevation, type a valid elevation in the scratchpad and press the line select key 2 or 6.

(d) To insert the tactical approach into the flight plan, select the **FPLN INSR** line select key. The Flight Plan page will be displayed and the message, INSRT V-APR BEFORE? will appear in the scratchpad. Press the line select key next to the desired waypoint to insert the approach at that point.

(e) If one or more of the FAF, MAP, or runway elevation parameters are missing, an attempt to insert the approach will result as an ENTER PARAMETERS message in the scratchpad.

(9) Deleting or Changing the FMS Approach. Once an FMS Approach of any type is in the flight plan it may be deleted or replaced with a different approach. Access the FMS approach pages via the **EDIT** key to access a working copy definition of the approach, or press the A or F attribute line select on the Flight Plan Waypoint page for the MAP or FAF waypoint to access the current flight plan definition.

Select the desired approach in the working copy approach definition and then select **FPLN MOD**. When the working copy replaces the existing approach, the existing approach is discarded. To remove the current approach procedure from the flight plan, access the current approach definition and select **FPLN RMV**.

(10) Approach Guidance and Leg Advance (Tactical/Visual Approach). Once an approach is defined, the sequencing from EN ROUTE to APPROACH guidance is automatic. When the aircraft is within 30 nautical miles of the FAF or runway extension point, the HSI lateral deviation display scaling switches to TERMINAL mode and a CDU annunciation √BAROSET reminds the pilot to enter the reported local barometric pressure setting for the airport of landing. For a tactical or visual approach, upon arrival at the FAF or runway extension point, the HSI lateral deviation display scaling switches to APPROACH mode and the flight plan switches from automatic (AUTO) to manual (MAN) sequence mode. Refer to Figure 3B-85.

(11) Published GPS Approach Guidance and Leg Advance. If the approach is a published GPS approach, then the approach sequence is somewhat

different from the tactical or visual approach, as shown in Figure 3B-86.

In a GPS approach, the APPROACH annunciation on the CDU flashes when the distance is 2 miles from the FAF, to alert the pilot of the transition to approach. The APPROACH annunciation is then displayed steady during the approach. At 2 miles from the FAF, the HSI deviation scaling transitions linearly from 1.0 nm full scale (TERMINAL) to 0.3 nm full scale (APPROACH) at the FAF and the GPS approach integrity performance is activated.

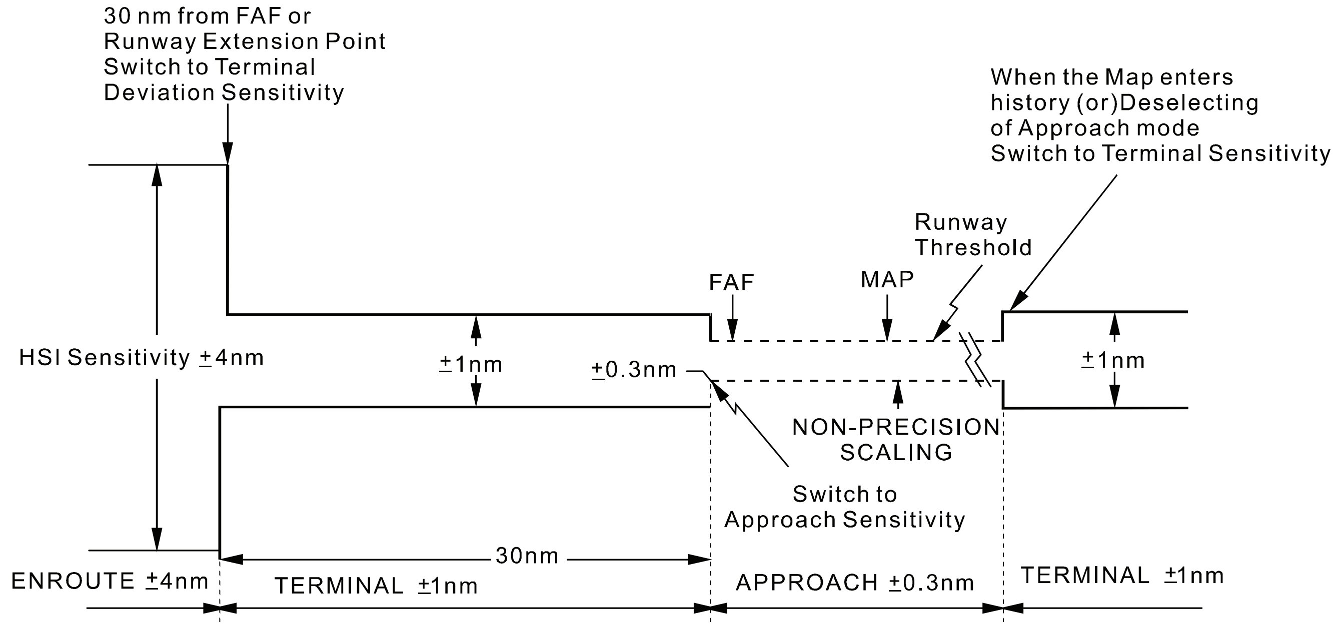


Figure 3B-85. Visual/Tactical Approach Scaling and Sequence

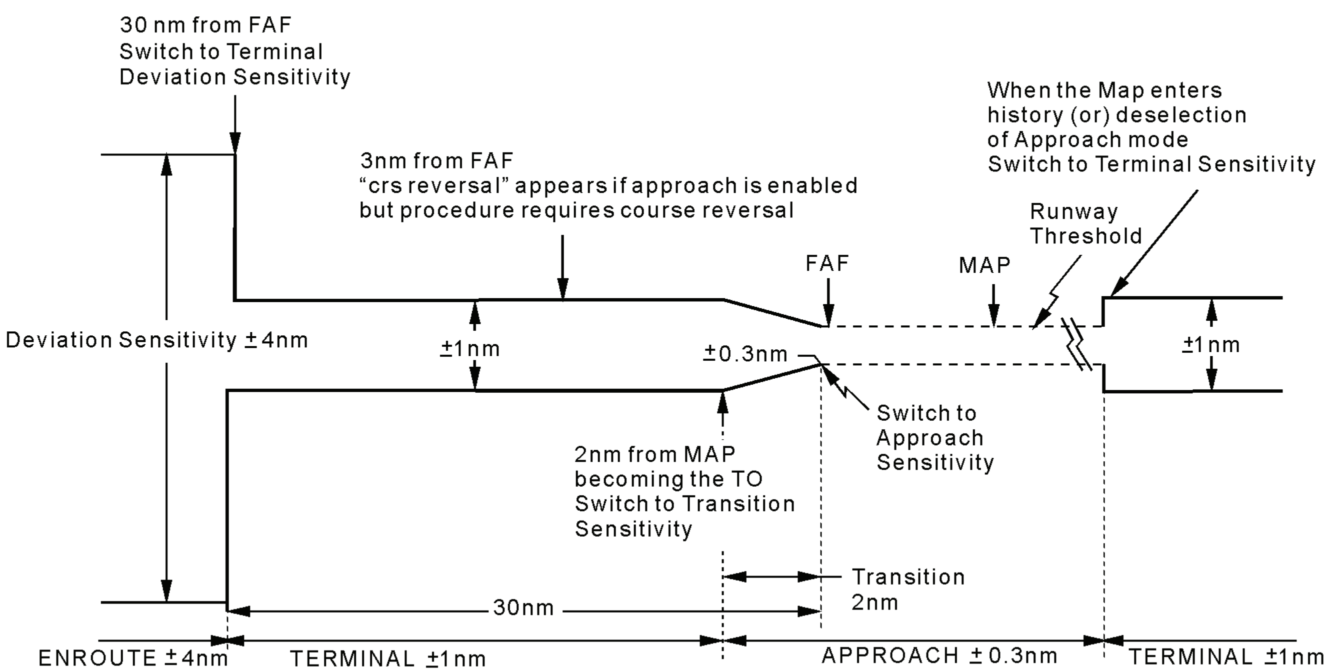


Figure 3B-86. Published GPS Approach Scaling and Sequencing

To sequence past the FAF into the GPS approach, the aircraft track must be within 90° of the final approach course and current leg course, and within 2 nm of the FAF waypoint. If not, the FMS will inhibit sequencing past the FAF waypoint and continue guidance for the inbound course to the FAF until the aircraft is maneuvered into the final approach configuration.

Once the aircraft sequences past the FAF waypoint, the sequencing mode of the FMS will switch to manual sequencing (MAN). Sequencing beyond the MAP is inhibited until the MAP is passed or a Direct-to is executed to a missed approach waypoint.

(a) DME Arc Guidance. If a published GPS overlay approach contains a DME arc leg, it is indicated by a D attribute on the right side of the Flight Plan page for the waypoint at the termination of the DME arc leg. The HSI and flight director/autopilot guidance will follow the arc and the distance display on the HSI, while on that leg will be the direct distance from the arc to the waypoint. The flight plan leg switching is normal. For and example of DME arc execution, refer to Figure 3B-87.

A Direct-To the endpoint of a DME Arc, when it is not the active waypoint, will cause the FMS to intercept the arc along the DME Arc leg. To intercept a Direct-To course directly to the DME Arc endpoint waypoint without intercepting the arc, select Direct-To the DME Arc endpoint again which will override the DME Arc leg intercept.

(b) Course Reversal Guidance. On selected GPS approaches, a published procedure turn may be defined for execution in the approach procedure. The FMS performs a course reversal procedure with standard holding pattern entry logic to execute the procedure turn. When the approach is inserted into the flight plan, the course reversal will be automatically enabled for execution. A C attribute will be identified next to the GPS approach IAF waypoint when the course reversal is enabled.

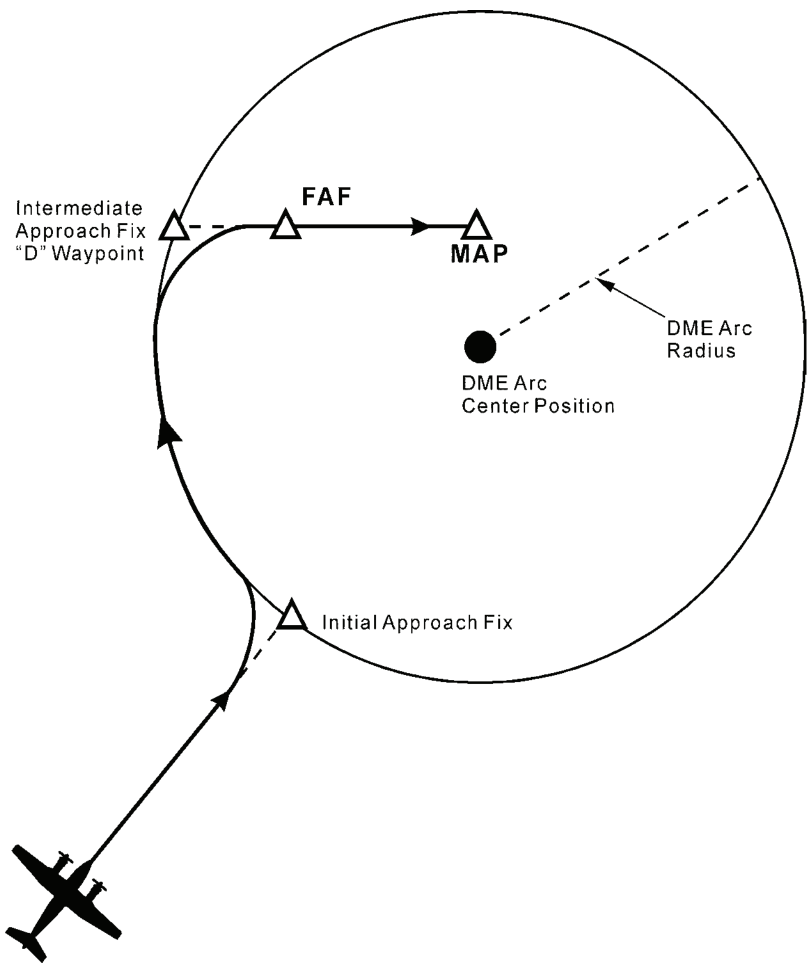


Figure 3B-87. DME Arc Flight Path

Execution of the course reversal will follow standard holding pattern entry logic. The definition of the course reversal procedure uses the holding pattern definition for the IAF waypoint. To review the course reversal definition, press the line select key adjacent to the C attribute on the Flight Plan and Flight Plan Waypoint pages to access the Holding Pattern page for the IAF waypoint.

The operator can modify the course reversal size (duration and length) when in the Holding Pattern page, but the course reversal course and turn direction can not be changed. Changes to the course or turn direction will automatically disable the course reversal procedure. When the course reversal is re-enabled, the published course and turn direction will be restored to the published definition.

Course reversal and holding pattern procedures at the IAF waypoint are mutually exclusive. Only one procedure can be enabled on the Holding Pattern page. To enable the course reversal, select the **ENBL RVS** line select on the IAF Holding Pattern page. This will also automatically disable the hold. When the hold is enabled while the course reversal is enabled, the course reversal will automatically be disabled.

If the pilot elects or ATC provides direct clearance for a NO PT approach, either delete the C attribute at the IAF, delete the IAF, or perform a Direct-to the FAF to avoid course reversal execution, as instructed by ATC. This action does not necessarily result in a straight in approach as when given radar vectors for final approach. To disable the course reversal, enter a **–** on the Flight Plan page and delete the C attribute at the IAF. If the course reversal is currently active, the aircraft will immediately turn inbound, as in holding pattern termination, and conclude the course reversal. Additionally, a Direct-to any waypoint while the course reversal is active will terminate course reversal guidance.

There are three types of course reversals typically defined within a GPS approach procedure. Refer to Figures 3B-88, 3B-89, and 3B-90, as follows:

1. IAF course reversal.

2. Collocated IAF/FAF course reversal.

3. Extended FAF course reversal.

In the collocated IAF/FAF and extended FAF type course reversals, the course reversal execution is actually performed at the FAF waypoint, even-though definition is provided with the IAF waypoint. In these two cases, the FAF holding pattern and IAF course reversal execution are mutually exclusive. If a holding pattern is enabled at the FAF, the course reversal will be disabled. Additionally, when the IAF holding pattern is disabled and an extended FAF course reversal is defined at the IAF, the course reversal to be executed into the FAF will be automatically re-enabled. This will ensure proper execution of the procedure turn at the FAF. However, if a holding pattern has been attached to the FAF, and the **H** attribute is subsequently deleted to disable the FAF hold prior to the hold execution, the course reversal procedure at the FAF is NOT automatically re-enabled. The operator must access the course reversal definition at the IAF and re-enable the course reversal to execute the reversal at the FAF.

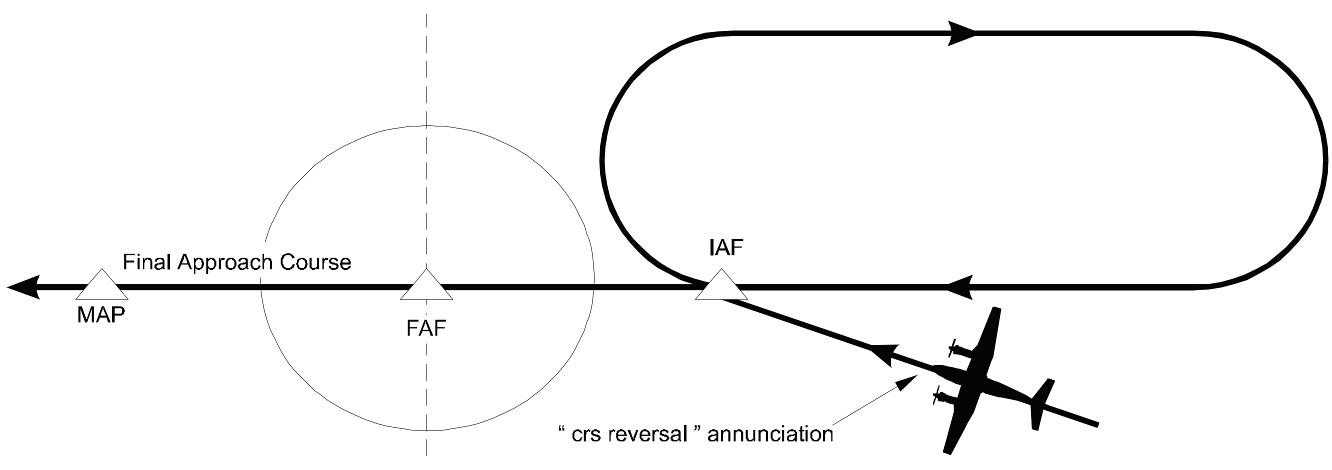


Figure 3B-88. Case I: IAF Course Reversal

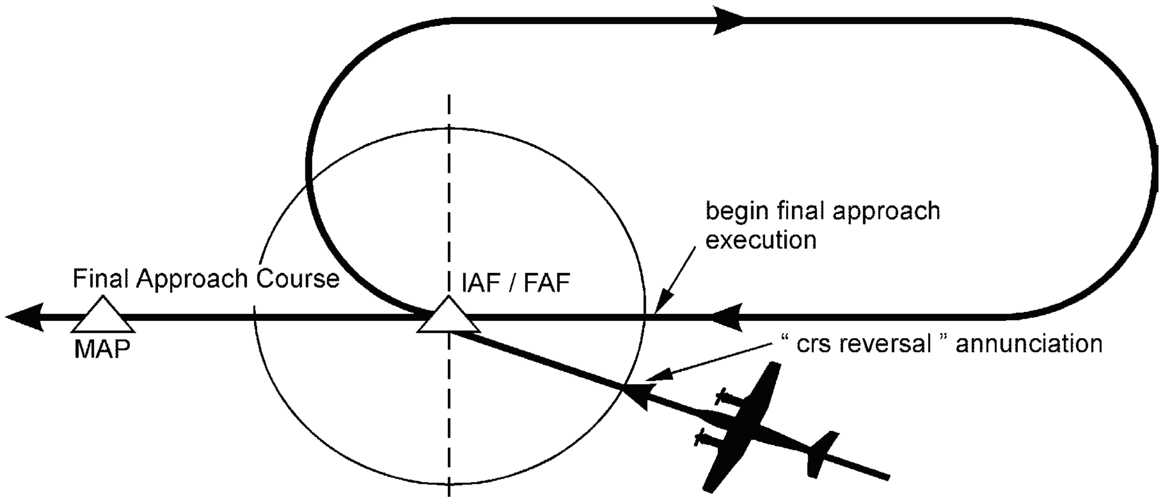


Figure 3B-89. Case II: Collocated IAF/FAF Course Reversal

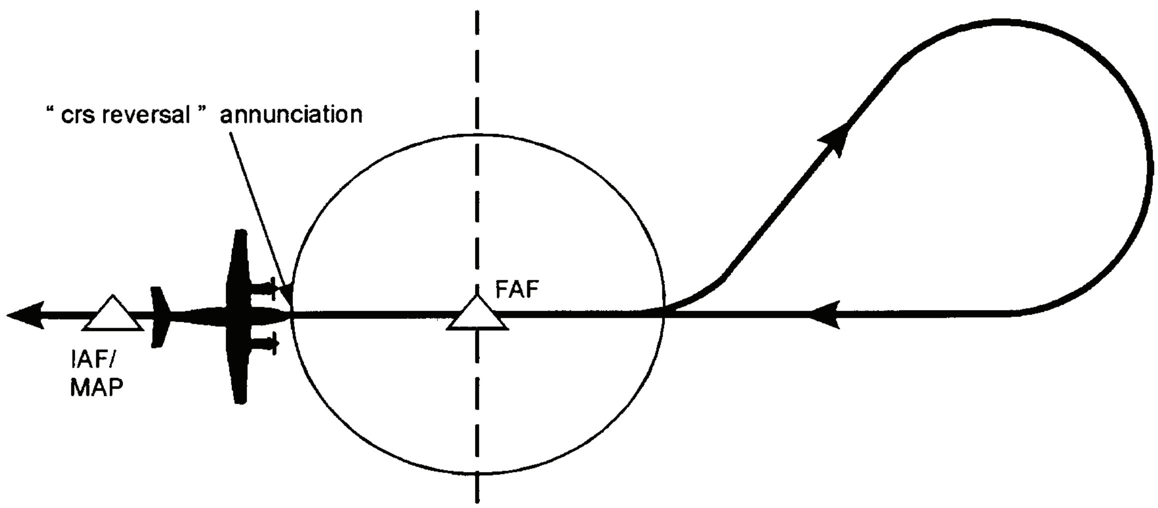


Figure 3B-90. Case III: Extended FAF Course Reversal

(12) Radar Vectoring to Final Approach. If ATC gives radar vectors to intercept the final approach course of an FMS approach, select Direct-to the FAF (F attribute waypoint) on the Flight Plan page. The FMS-800 will display the message FINAL COURSE XXX° where XXX is the final approach course, as shown in Figure 3B-91, but will execute a course direct-to the FAF. To intercept the final approach course, select the CRS line select with the FINAL COURSE displayed in the scratchpad. The FMS will provide lateral guidance to guide the aircraft to intercept the final approach course into the waypoint.

The final approach course will be displayed on the HSI and CDU. The FMS will provide lateral guidance to directly intercept the final approach course and vertical guidance to intercept the final approach glideslope into the FAF waypoint. To follow the radar vectors, activate the FMS Heading Mode by pressing the Heading knob on the flight instrument control panel. The FMS will then provide guidance to continually capture the selected heading from the flight instruments until the final approach course has been captured.

The FMS roll command will guide the aircraft to acquire and hold the displayed heading and any subsequent desired heading entered by the pilot on the FDS control panel. The FMS Heading Mode will continue to guide to the FDS selected heading as long as the heading is steering away from the flight plan course. When the selected heading is steering towards the flight plan course, the FMS Heading Mode will automatically cease when the course can be captured by normal FMS lateral guidance.

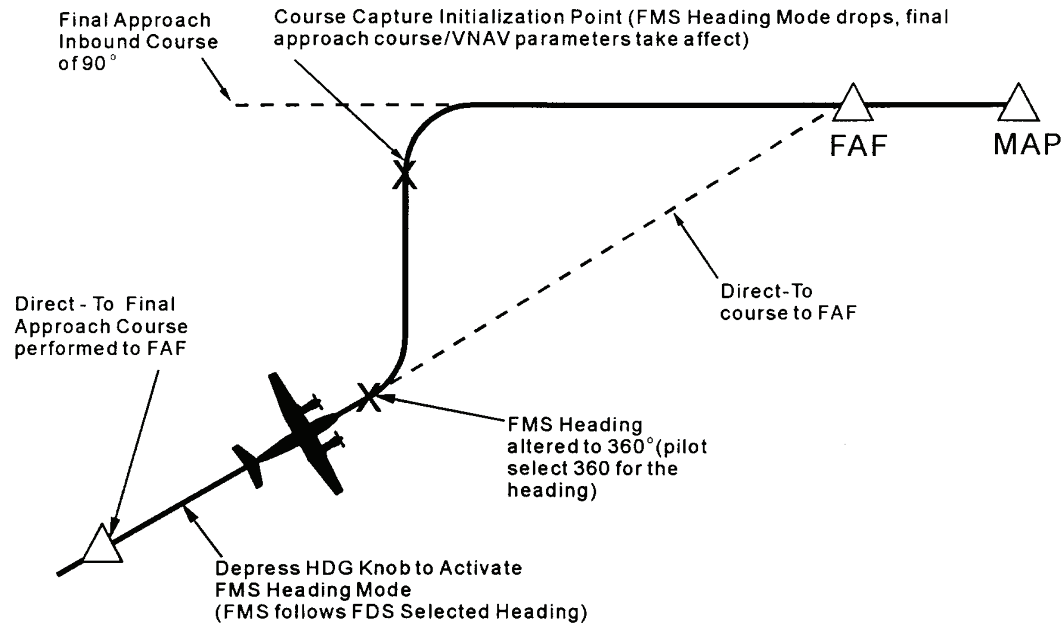


Figure 3B-91. Final Approach Vectoring

(13) Missed Approach Guidance. While the FAF or MAP waypoint is the active waypoint and approach mode is active, the pilot may disable the approach either by pressing the go-around switch on the aircraft control yoke or perform a Direct-To another waypoint other than the MAP. When disabled by go-around, the FMS flight mode will switch to TERMINAL mode scaling, but lateral guidance will continue to be provided through the MAP waypoint. Vertical guidance advisories on the CDU will be terminated when the approach is disabled. To re-enable the approach, select direct-to the FAF or any other flight plan waypoint that would place the FAF as a future flight plan waypoint.

If the Navigation Flag on the flight instruments is displayed (red FMS annunciation), and the RAIM Warning, NO GPS APPR, or annunciations are active, disable the GPS approach and go-around for another approach. The RAIM Warning annunciation on the flight instruments indicates that the GPS solution is possibly false due to satellite system failures. The NO GPS APPR annunciation indicates there is not a satisfactory GPS solution being provided to execute the GPS approach. The NO APPR RAIM annunciation indicates that the GPS receiver is unable to determine the suitability of the satellite constellation during the approach phase of the flight.

If a missed approach is executed, either perform a Direct-To the missed approach holding fix and fly the published holding pattern or select Direct-To the IAF or FAF (in history) and be vectored for another approach. When the MAP is the active waypoint, pressing the **CRS** select Knob on the EFIS Display Control Panel will perform a Direct-To the missed approach holding point rather than the MAP.

NOTE

If providing steering guidance through the flight director, the FMS will command the flight director to turn the shortest distance to the missed approach holding point. This direction of turn may conflict with published missed approach procedures.

When the MAP is the active waypoint, flight plan sequencing will be inhibited on the TO side of the MAP. On the FROM side of the MAP, AUTO sequencing may be selected by the operator to go to the next waypoint. To sequence to the missed approach holding point or other waypoints following the MAP in the flight plan, delete the discontinuity after the MAP (otherwise, the FMS sequences into the discontinuity), then select AUTO sequencing on the Flight Plan page. The next waypoint will become the active waypoint, with the inbound course into the new active waypoint established by the geometry between the MAP and the active waypoint. To change the inbound course to the new active waypoint, enter the desired CRS on the Flight Plan page. If a holding pattern is enabled at the active waypoint, the FMS will provide entry guidance into the holding pattern.

(14) Flight Plan Discontinuities. A discontinuity in the flight plan may occur when using approaches. A discontinuity is associated with a waypoint and

requires crew action to resolve in order to obtain proper flight plan sequencing. The waypoint associated with the discontinuity can be either the one proceeding, following, or both. A discontinuity is inserted into the flight plan under the following two conditions:

1. Following a MAP when inserted in the flight plan.

2. Following a MAP when a direct-to puts the history FAF and MAP waypoints as future waypoints.

The VERIFY PROC annunciation and CDU alert are displayed when one minute to go before sequencing into the discontinuity. If the discontinuity becomes the active waypoint, a DISCONTINUITY annunciation is displayed and guidance is provided for wings-level flight.

The discontinuity is resolved by the following methods:

1. Delete the discontinuity.

2. Delete the waypoint with which the discontinuity is associated with.

3. Insert a waypoint between the discontinuity and the waypoint it is associated with.

4. Remove the approach from the flight plan (except if the discontinuity is the active waypoint).

5. Perform a Direct-to while in the discontinuity.

n. Mission Flight Patterns.

(1) Mission Flight Pattern Overview. The FMS-800 allows definition of special Mission Flight Patterns (MFP's) to meet specific operational requirements for military operations. The four MFP's are:

1. Racetrack.

2. Figure eight.

3. Circle.

4. Closed Random Pattern (CRP).

The FMS-800 provides guidance within each pattern type including entry flight procedures similar to those used for holding patterns.

Any MFP may be associated with up to 20 fixed waypoints in the flight plan. When the aircraft crosses a pattern fix, the pattern guidance is activated suspending normal leg advance until the MFP is exited.

(2) MFP Definition. Each pattern provides a definition on the MFP page. To create a new MFP, access the MFP pages from the Pattern page. Refer to Figure 3B-92 and Table 3B-64. There are four parameters that define the racetrack and figure eight patterns as follows:

1. Inbound Course.

2. Turn Direction.

3. Pattern Length.

4. Pattern Width.

(3) Circle patterns require all parameters defined above except for pattern length. MFP geometry definitions are shown in Figure 3B-93.

CRP's are special patterns made up of crew defined points connected together to form an enclosed flight path. A CRP may be flown in repeated forward or reverse sequence.

(4) MFP Entry Guidance. The FMS-800 provides entry guidance into MFP's similar to that for holding patterns.

(5) Designation of the Pattern Fix. The pattern fix can be specified either directly on the MFP pages or by attaching a MFP to a flight plan waypoint. To specify the pattern fix on the MFP page and insert it in the flight plan, press the **FPLN INSR** line select key on the MFP page. This accesses the Flight Plan page with INSERT XXX BEFORE? in the scratchpad. Where XXX is either FG8, RTK, CIR, or CRP depending on which type of MFP was defined. After the flight plan is scrolled to the desired location, press the line select key adjacent to the waypoint, which will follow the pattern fix.

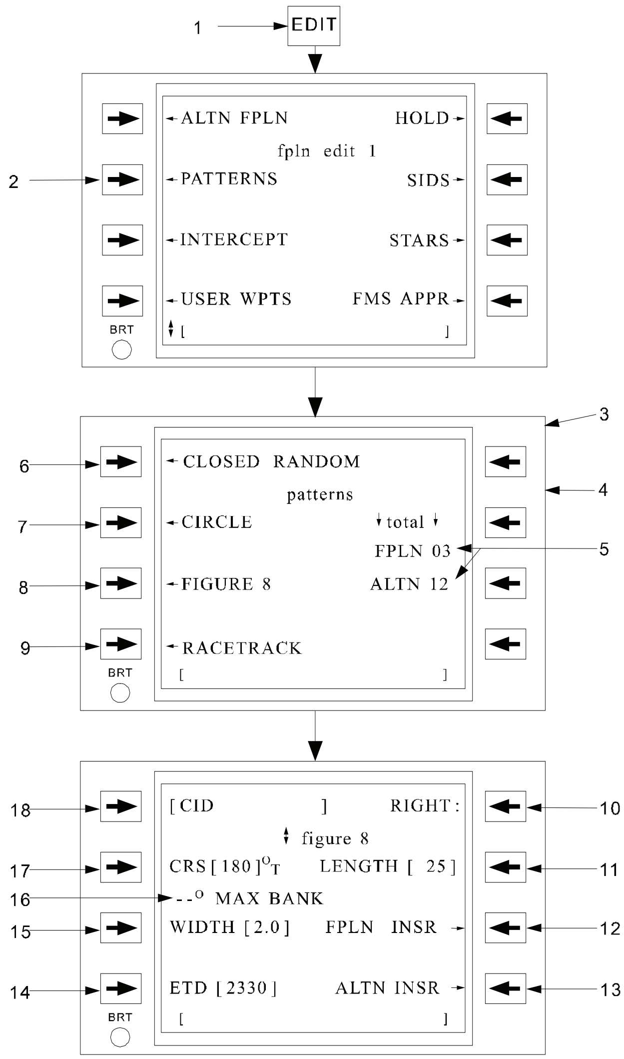


Figure 3B-92. MFP Page Access from the Patterns Page

Table 3B-64. MFP Page Access from the Patterns Page

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Select the patterns page.
3	Select the desired pattern.
4	Enter pattern data and insert the pattern into the active or alternate flight plans.
5	Indicates the total number of MFP's currently in the flight plan and alternate flight plan.
6	To access the Closed Random Pattern MFP page.
7	To access the Circle MFP page.

Table 3B-64. MFP Page Access from the Patterns Page (Continued)

NO.	DESCRIPTION/FUNCTION
8	Access the Figure 8 MFP page (figure 8 is used as an example).
9	To access the Racetrack MFP page.
10	Select LEFT or RIGHT turns.
11	Insert pattern length.
12	To access the Flight Plan page and insert the pattern.
13	To access the Alternate Flight Plan pages and insert the pattern.
14	Insert estimated time of departure (optional).
15	Insert pattern width.
16	Computed maximum bank limit for pattern width.
17	Insert pattern inbound course (optional).
18	Insert pattern fix (optional).

To attach a MFP to an already existing flight plan waypoint, define the MFP but leave line 1 blank on the MFP page. Press line select key **FPLN INSR** to access the Flight Plan page with the message ATTACH XXX AT? in the scratchpad. Where XXX is either FG8, RTK, CIR, or CRP depending on which type of MFP was defined. After the flight plan is scrolled to the desired location, press the line select key adjacent to the pattern fix.

A P is displayed to the right of the designated waypoint as a reminder that it has been designated as the pattern fix.

Once an MFP has been inserted into the flight plan, the MFP parameters can be viewed and modified (with the exception of the pattern fix) by pressing the line select key adjacent to the associated P symbol on the Flight Plan page. Pressing this key once will access the associated Flight Plan Waypoint page and a second time will access the MFP Waypoint page.

(6) MFP Pattern Course Edits. The pattern course is entered by two different methods as follows: In either case, the course can be modified.

1. Defaulting to the current inbound course to the fix.

2. The crew enters the desired course via the scratchpad.

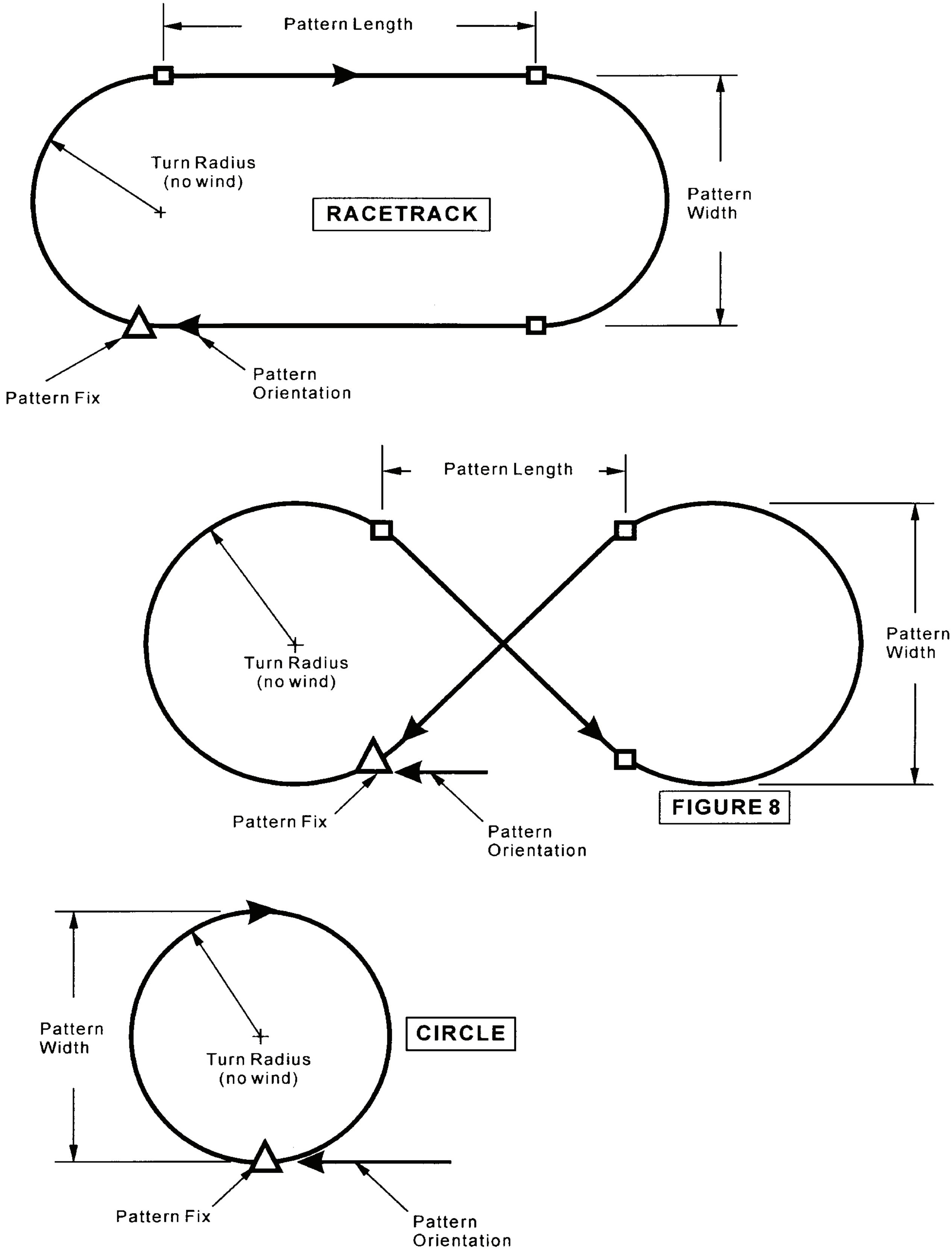


Figure 3B-93. MFP Geometry Definitions

(7) MFP Activation and Execution. This paragraph describes activation and execution of racetrack, figure eight, and circle MFP's (not CRP's).

When the pattern fix is passed for the first time, pattern guidance computations are activated. At this time, four changes occur in both the flight plan operation and page displays as follows:

1. Automatic leg advance is suspended.

2. Course edits on the Flight Plan page may no longer be made. Inbound pattern course edits may be made on the MFP Waypoint page, which is accessed through the Flight Plan Waypoint page.

3. When on the inbound leg, all displays will reference the computed inbound course (not necessarily the inbound course displayed on the MFP page. Computed inbound course for figure eight patterns is significantly different than displayed inbound course.)

4. When on the outbound leg, the displays will reference the computed outbound course.

If any MFP definition parameters are changed while in the pattern, the changes are applied after the aircraft passes the pattern fix (transition from TO to FROM), except for the pattern length and width, which take effect immediately if on the outbound leg.

When pattern guidance has been activated, all course and lateral deviation displays now reference the computed inbound or outbound course of the pattern. The 10 second turn alert will be computed on the outbound leg to alert the crew of the upcoming turn to the inbound leg.

(8) CRP Definition and Execution. CRP's are defined by entering points (i.e., identifiers, latitude-longitude positions, etc.) on the CRP MFP pages 1 through 3. Up to nine waypoints (in addition to the fix point, which is optional) may be specified. To specify the MFP fix on the CRP MFP pages, enter the position at the FIX line on CRP MFP page 1.

CRP's will only be executed upon arrival at the CRP fix if AUTO or FLYOVER sequence mode is selected. If manual (MAN) sequence mode is selected the fix is overflown. To insert the pattern, toggle the sequence mode to **AUTO** or **FLYOVER**.

Once the CRP is being executed guidance is provided to each point in the CRP as if they were flight plan waypoints. An * is displayed adjacent to the CRP waypoint number of the current TO waypoint, which is on the associated CRP MFP page.

To fly directly to any CRP pattern point, press **DIR**. Instead of selecting the line selects on the left-hand side of the Flight Plan page, select the **P** attribute of the CRP fix waypoint on the right hand line select. This action will access the CRP Patterns page and allow selection of the CRP point for Direct-to flight.

(9) Maximum Bank Angle. When an MFP is inserted in the flight plan, the FMS-800 computes and displays the maximum bank angle allowing for proper execution of the pattern based on pattern width and aircraft speed (if airborne). The maximum bank is displayed on line 4 of the MFP Waypoint page.

(10) Estimated Time Of Departure. The Estimated Time of Departure (ETD) entry permits future waypoint ETA's to be more realistically calculated. If an ETD is entered (in UTC), then all future waypoint ETA's are calculated from that pattern fix departure reference. If no ETD is entered or it is deleted, then all future ETA's are calculated as if no loiter time will be spent in the MFP.

(11) Exiting The MFP. Performing a Direct-To another waypoint besides the pattern fix are the only ways to terminate MFP's. This places the pattern fix waypoint into history.

o. Intercept Operations.

(1) Intercept Calculations. Up to 10 moving targets may be simultaneously defined. Intercept solutions to these targets may be inserted as either the active waypoint for immediate (Direct-To) execution or as a future waypoint to implement a future intercept of a moving target. Figure 3B-94 and Table 3B-65 illustrate how to define moving waypoint parameters for use in intercept solutions.

The intercept computations determine the true minimum time to intercept to the moving waypoint. This is not a homing type solution. If interception is not possible, the Point of Closest Approach (PCA) (i.e., the location where the target will be the closest) is computed and "PCA Intercept" will be annunciated when the intercept is the active waypoint.

Solutions are regularly computed for all intercepts whether inserted in the flight plan or not. If an intercept has not been inserted, the computations are performed as if it were a Direct-To intercept from present position.

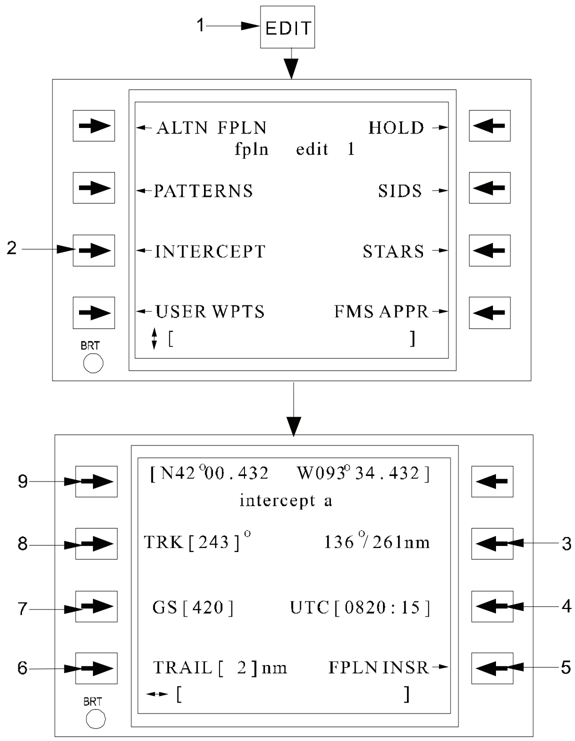


Figure 3B-94. Intercept Definition

Table 3B-65. Intercept Definition

NO.	DESCRIPTION/FUNCTION
1	Pressing **EDIT** function key will access the Edit page
2	Press to access the Intercept A page
3	Displays the current bearing/distance to target, NOT to intercept point.
4	Insert target fix time; defaults to the UTC in effect when the target fix was inserted.
5	Access Flight Plan page for insertion or removal of intercept from flight plan.
6	Insert the intercept in trail distance (defaults to zero).
7	Insert the reported target groundspeed.
8	Insert the reported target track.
9	Insert the reported target fix.

(a) Direct Intercept. When an intercept is the active waypoint, the intercept location is regularly updated based on the following:

1. Current own aircraft position and speed.

2. Moving target definition.

3. Current wind.

The intercept point location is adjusted as required and the inbound course is edited to match the current Direct-To course into the waypoint. To perform a direct intercept perform the following procedures:

1. Enter the desired parameters on the Intercept A page.

2. Press the **FPLN INSR** line select key.

3. Press the line select key adjacent to the TO waypoint location. Refer to Figures 3B-95 and Table 3B-66.

(b) Planned Intercepts. When the intercept is inserted as a future waypoint, the intercept location is regularly updated based on the following:

1. Location of the flight plan waypoint immediately prior to the intercept.

2. Distance along the flight plan from aircraft position to the waypoint prior to the intercept.

3. Current own aircraft speed.

4. Moving target definition.

5. Current wind.

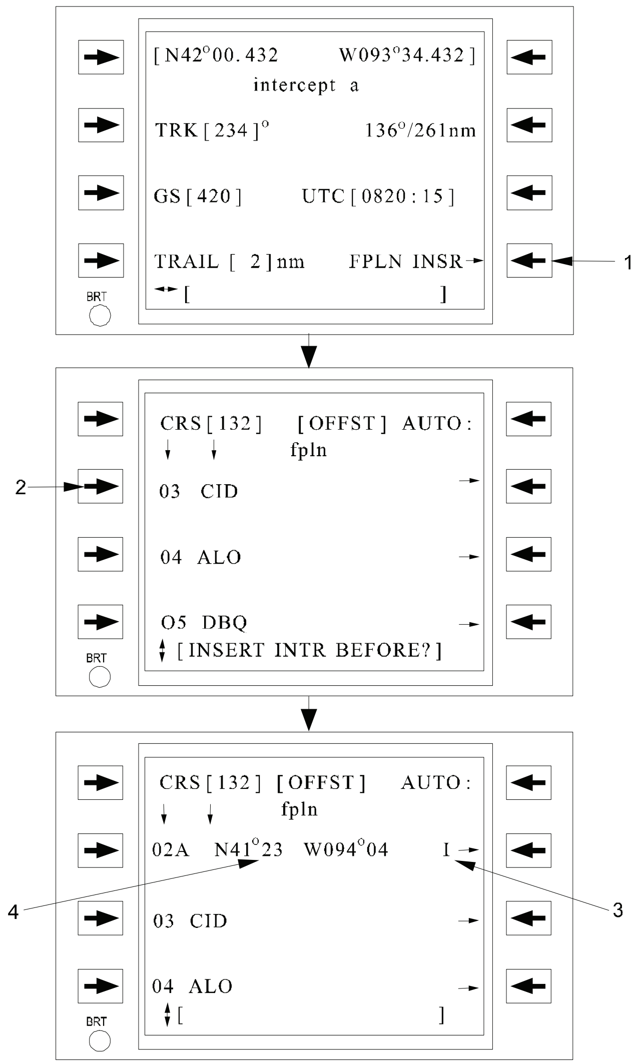


Figure 3B-95. Direct Intercept Insertion

Table 3B-66. Direct Intercept Insertion

NO.	DESCRIPTION/FUNCTION
1	When the intercept has been defined, pressing **FPLN INSR** line select key will access the flight plan.
2	Inserts the intercept before this point in the flight plan (in this case, a direct intercept is being performed).
3	An I indicates that an intercept has been attached to this waypoint.
4	Intercept position is displayed as a LAT-LONG and is updated every 22 seconds.

The estimated time of arrival at the waypoint immediately prior to the intercept is computed. Then the intercept point and its ETA is computed from that point in exactly the same manner as the direct case. The intercept is executed exactly as the direct intercept when it becomes active. Refer to Figures 3B-96 and 3B-97.

(2) Intercept Passage. When an intercept is passed into history the latitude-longitude of the intercept at the time of waypoint passage is recorded as the flight plan history waypoint. The I is removed from the waypoint.

(3) Multiple Intercepts. Ten moving waypoint (intercept) definitions may be inserted in the flight plan. Each intercept solution is computed independently and flown in the flight plan sequence.

(4) Alternate Intercept Solution. A calculator function is provided to allow the crew to enter an alternate true airspeed and see the affect on the intercept. This calculator is available for an intercept not inserted into the flight plan and for the next intercept in the flight plan. Refer to Figure 3B-98 and Table 3B-67.

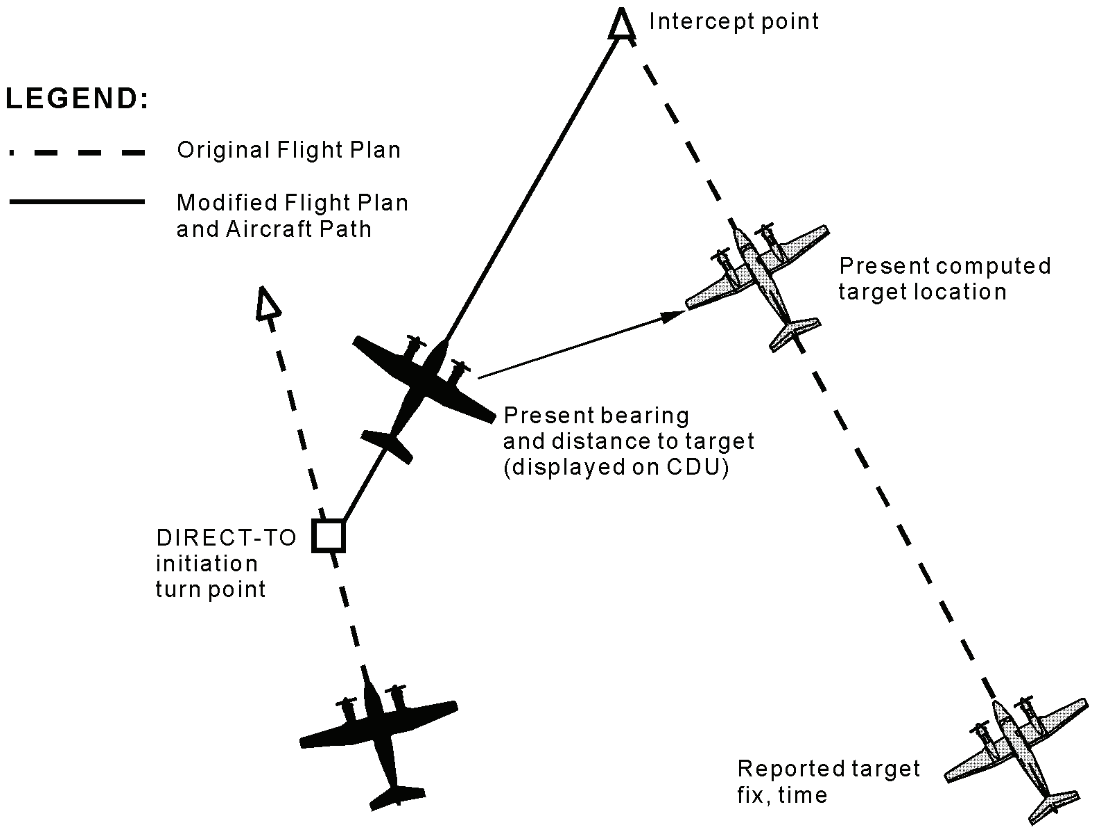


Figure 3B-96. Direct Intercept

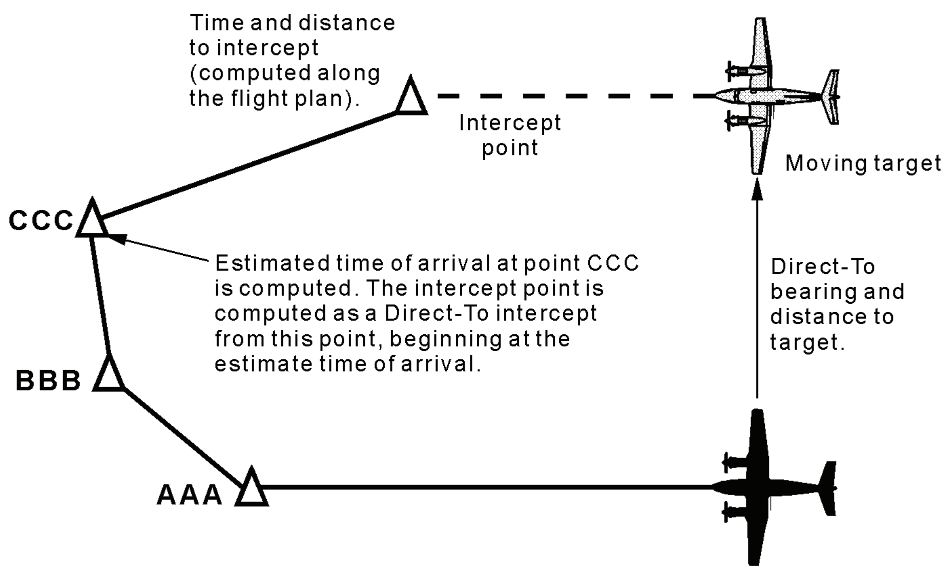


Figure 3B-97. Future Intercept Geometry

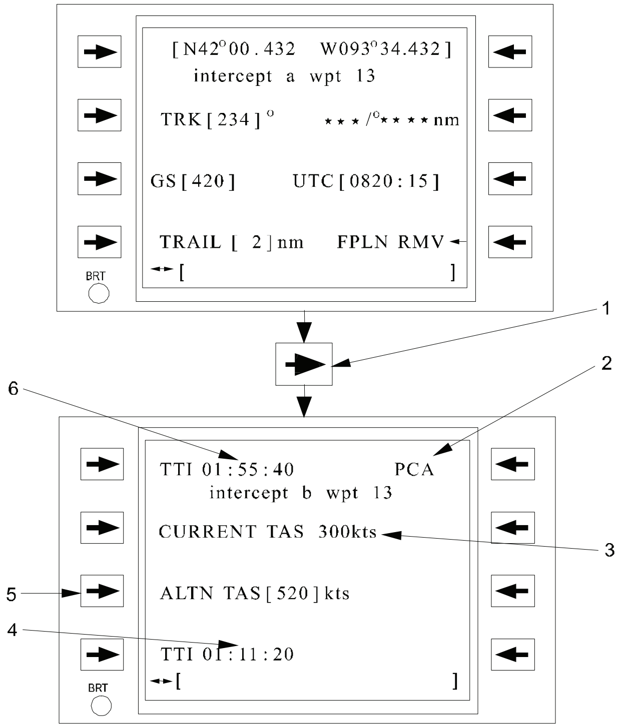


Figure 3B-98. Intercept Function Calculator

Table 3B-67. Intercept Function Calculator

NO.	DESCRIPTION/FUNCTION
1	Scroll laterally to the B page for intercept calculator solution.
2	The PCA indicates the intercept is not possible.
3	The aircraft current true airspeed.
4	Time to intercept based on alternate airspeed.
5	Insert alternate true airspeed for calculator solution.
6	Time to intercept or PCA (intercept not possible in this example).

p. Markpoint and Waypoint List Storage.

(1) Markpoint and Waypoint List Overview. The FMS-800 maintains a markpoint list of up to 10 markpoints and a user waypoint list of up to 200 waypoints. The lists are stored in nonvolatile memory. Each list is maintained on separate pages and are accessed from the Flight Plan Edit page. Refer to Figure 3B-99 and Table 3B-68. To access the Markpoint List page, press the **MARKPT** line select key on the Flight Plan Edit page. To access the Waypoint List page, press the **USER WYPT** line select key.

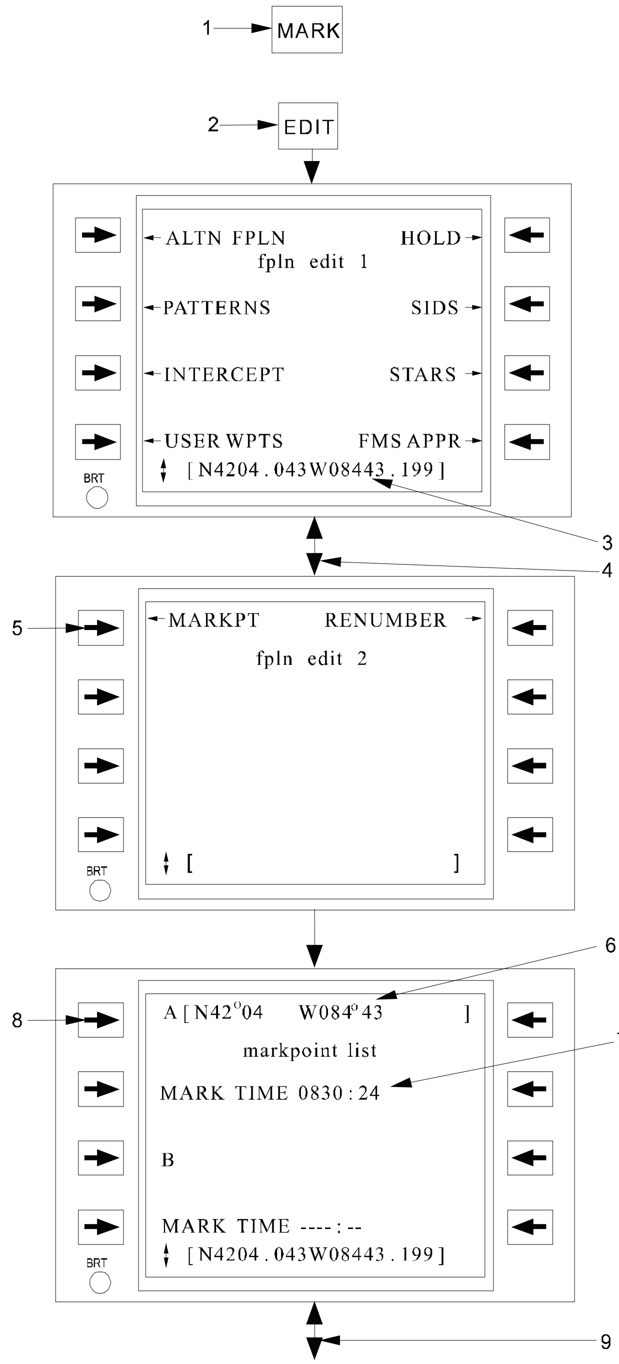


Figure 3B-99. Markpoint List and Waypoint List Page Access and Usage

Table 3B-68. Markpoint List and Waypoint List Page Access and Usage

NO.	DESCRIPTION/FUNCTION
1	Mark waypoints regardless of which CDU page is displayed.
2	Pressing **EDIT** function key will access the Edit page.

Table 3B-68. Markpoint List and Waypoint List Page Access and Usage (Continued)

NO.	DESCRIPTION/FUNCTION
3	Mark position recorded in the scratchpad and in the markpoint list.
4	Scroll to the Flight Plan Edit 2 page.
5	To view markpoints, access the Markpoint List page.
6	Mark position recorded in the markpoint list.
7	Mark time is recorded automatically.
8	Possible entries at the A line select key: Press with a **–** in scratchpad to delete the point. Press with an empty scratchpad to copy the point to the scratchpad. Enter **I** with identifier name to name the markpoint location and add it to the user waypoint list.
9	Scroll vertically to view other markpoints.

(2) Markpoint List. To create a markpoint, press the **MARK** function key when the desired position is overflown. Pressing the **MARK** key will indicate in the scratchpad the designated pilot's present position solution offset by any active cursor position as displayed on the FDS, and automatically adds the position to the markpoint list (on the Markpoint List page). It assigns the markpoint a unique letter identifier (A through J), and records the mark time. The Markpoint List page does not need to be displayed to use this function.

Once the markpoint is on the Markpoint List page, it is treated like any other waypoint and can be copied, inserted elsewhere, or deleted. The marked position in the scratchpad can be inserted as a waypoint or position. It can be cleared with the **CLR** key.

If 10 markpoints exist on the Markpoint List page and another mark is performed, the new mark overwrites the first (oldest) mark in the list. A subsequent mark overwrites the second, and so on.

Manual position entries are not allowed on the Markpoint List page. To store entered waypoints manually, see the Waypoint List page.

(3) Waypoint List. The user waypoint list is a list of up to 200 user defined waypoint identifiers that the user can predefine for use in the FMS. Once a user waypoint is created, it can be recalled, copied, and used like any identifier from the primary ICAO database stored on the data cartridge. The user waypoint list is maintained in non-volatile memory of the CDU, so user defined waypoints are maintained through power cycles.

To create a user waypoint, access the User Waypoint List page as shown in Figure 3B-100 and Table 3B-69. Select the **NEW** line select key to access a blank waypoint definition. On the User Waypoint page, give the new waypoint a name and a location. The location can be a latitude/longitude, another waypoint identifier, or bearing/distance offset from an identifier. Select the waypoint type from the following selections: FIX, VOR, VORTAC, TACAN, VOR/DME, NDB, NDB/DME, DME, or AIRPORT. If a nav aid type is selected, enter the associated nav aid frequency and station declination. If desired, enter the elevation of the user waypoint. When all elements have been completed, RTN will switch to ADD and the new user waypoint can be inserted into the user waypoint list. If a user waypoint already exists with the same name, a prompt will appear to confirm overwriting the old waypoint definition. To prevent an overwrite, press **CLR** or confirm to overwrite.

To use the new user waypoint, simply recall the waypoint by name on the Flight Plan page or any other FMS page that uses ICAO identifier waypoints, or copy the waypoint from the User Waypoint List page. The User Waypoint list page includes a search utility to help find a desired waypoint, or simply scroll through the list to view waypoints in alphabetical order.

To modify or review the definition of a user waypoint, access the user waypoint list page and select the right line select adjacent to the waypoint to be modified. Modify the user waypoint definition on the User Waypoint page and reinsert the new waypoint when complete.

To delete a user waypoint, access the User Waypoint List page, enter a – in the scratchpad, and press the left line select key adjacent to the user waypoint to be deleted. When 200 user waypoints have been defined in the list, the FMS will prevent any more additional waypoint entries. To add more user waypoints, current user waypoints must be deleted first.

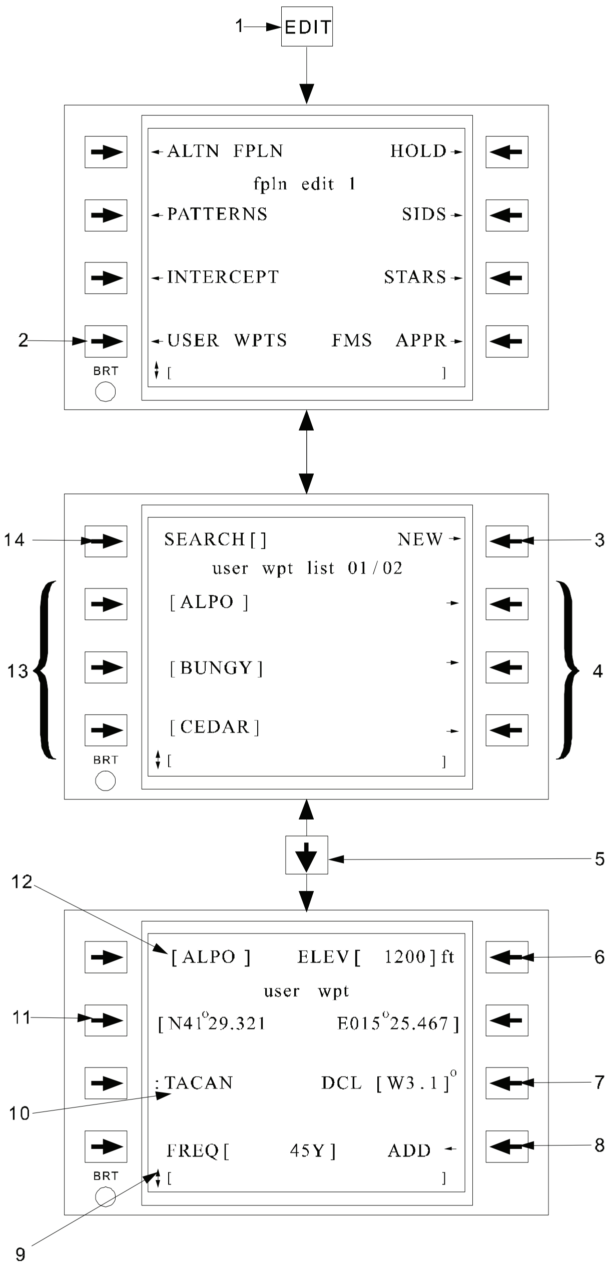


Figure 3B-100. User Waypoint List Access and Use

Table 3B-69. User Waypoint List Access and Use

NO.	DESCRIPTION/FUNCTION
1	Pressing **EDIT** function key will access the Edit page.
2	Press to access User Waypoint List.
3	Select to create a new user waypoint from scratch.
4	Select to review or edit a current waypoint definition.
5	Scroll vertically to view other user waypoints in alphabetical order.
6	Enter user waypoint ground elevation (optional).
7	Enter waypoint station declination, if needed.
8	Select to add to or modify waypoint list.
9	Enter waypoint station frequency, if needed.
10	Select waypoint type.
11	Enter location of user waypoint.
12	Enter name of user waypoint.
13	Copy or delete the current user waypoint.
14	Enter a user waypoint identifier to search for.

(4) User Waypoint Naming. Waypoints within the FMS can be given a user defined identifier name by applying a **/** followed by the desired waypoint name Figure 3B-101 and Table 3B-70. Valid waypoints that can be named by this function are latitude/longitude and ident/bearing/distance waypoints. ICAO identifier or existing user defined waypoints can not be renamed with the user waypoint naming function.

To apply a user waypoint name to a waypoint, and insert that waypoint into the User Waypoint List, enter a / followed by a waypoint name consisting of two to five characters. This name can be applied to waypoints on the Flight Plan, Alternate Flight Plan Waypoints, Alternate Flight Plan Leg A, MFP, Tactical Approach, Markpoint, RAIM Prediction, and Update pages. Once inserted into the User Waypoint List, the newly named waypoint can be used like any other ICAO identifier waypoint.

To complete the definition of the named waypoint, access the User Waypoint page for the named waypoint and change the desired parameters in the waypoint definition. The default definition is for a FIX waypoint with undefined elevation.

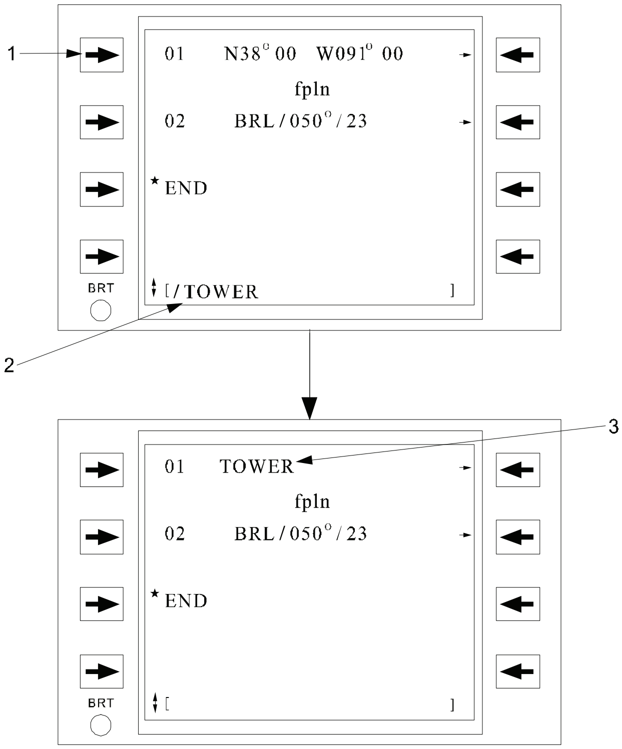


Figure 3B-101. Creating User Named Waypoints

NOTE

New name can be copied or entered like any other ICAO identifier waypoint. Access the User Waypoint page to modify the user waypoint definition.

Table 3B-70. Creating User Named Waypoints

NO.	DESCRIPTION/FUNCTION
1	Enter name in the scratchpad, prefixed with a /.
2	Apply name to waypoint.
3	New name is now associated with this waypoint.

If the User Waypoint List is full when the name is applied to a waypoint, a USER WPT LIST FULL message will be displayed. Access the User Waypoint List and delete any unused or no longer needed waypoints to allow continued naming of waypoints. If the user waypoint name already exists in the user waypoint list, a DUPLICATE USER WPT message will be displayed. Use a different name or delete the repeated name from the User Waypoint List. The FMS only allows one name to be used for each waypoint in the Use Waypoint List. User waypoint identifiers can be duplicates of identifiers in the ICAO database. When using the named waypoint with an ICAO duplicate, the Select Waypoint page will be accessed to allow selection of the desired waypoint. The user named waypoint is identified on the Select Waypoint page with ** as the country code.

q. From-To And Waypoint Data Pages.

(1) Data Page Overview. Independent of the active and alternate flight plans, the FMS-800 will compute, on demand, the bearing/distance, distance along the active flight plan, and ETE/ETA for a variety of FROM-TO waypoint pairs and direct options selected by the crew. These options include the following. Refer to Figure 3B-102:

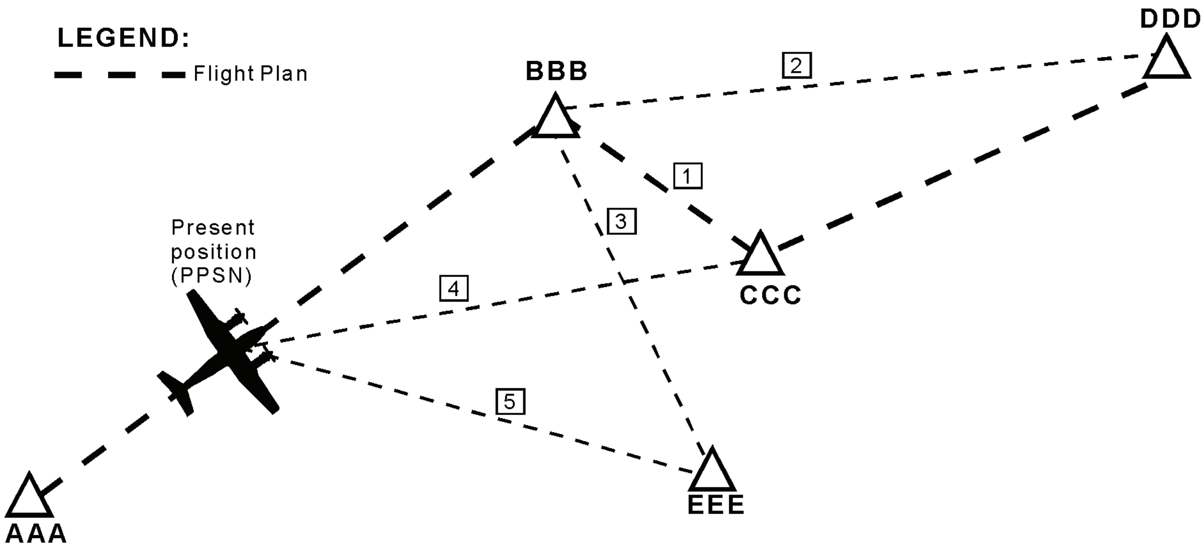
1. FROM any active flight plan waypoint TO the next succeeding flight plan waypoint.

2. FROM any flight plan waypoint TO any other flight plan waypoint.

3. FROM any flight plan waypoint TO a non-flight plan waypoint.

4. FROM aircraft present position TO any flight plan waypoint.

5. FROM aircraft present position TO any non-flight plan waypoint.



Option 1: BBB to CCC (flight plan waypoint to next flight plan waypoint)
Option 2: BBB to DDD (flight plan waypoint to other flight plan waypoint)
Option 3: BBB to EEE (flight plan waypoint to non-flight plan waypoint)
Option 4: PPSN to CCC (present position to flight plan waypoint)
Option 5: PPSN to EEE (present position to non-flight plan waypoint)

Figure 3B-102. FROM–TO Options for the Data Page (Examples Only)

(a) Data Page Access and Waypoint Entry. To access the Data page, press the **DATA** function key. Then press the line select key adjacent to any waypoint in either the active flight plan, alternate flight plan, waypoint list, or markpoint list. Refer to Figure 3B-103 and Table 3B-71 for an example of Data page access.

After the Data page has been accessed, other TO waypoints may be selected or entered; also, FROM-TO display options can be selected.

If the initially selected waypoint is a flight plan waypoint, press the vertical scroll key ⌉ or ⌋ to scroll leg by leg through the flight plan. This is option number 1 in Figure 3B-102.

To freeze the FROM waypoint, press the line select key to select **WPT**. Then press the ↑ or ↓ arrow keys to scroll from waypoint to waypoint through the flight plan while retaining the same FROM waypoint, Option 2, Figure 3B-102.

To view a direct segment FROM a flight plan waypoint TO a non-flight plan waypoint, scroll the flight plan in the LEG mode until the desired FROM waypoint is at the top of the page. Then insert the desired TO waypoint on data line 2 in place of the existing TO waypoint, Option 3, Figure 3B-102.

To view data from present position to any flight plan waypoint, scroll the flight plan so that the desired TO waypoint is on data line 2. Then select either **PPSN DIRECT** or **PPSN VIA FPLN** at line select key 1L, Option 4, Figure 3B-102.

To view data from present position to a non-flight plan waypoint, select **PPSN DIRECT** and insert the desired waypoint in place of the TO waypoint on data line 2, Option 5, Figure 3B-102.

(b) Data Page Displayed Information. The Data page presents data related to the selected DATA FOR? waypoint which is called the TO waypoint of the FROM-TO waypoint pair, shown on data line 2 in Figure 3B-103. It also shows data for the FROM-TO leg and the ETA for a hypothetical flight either via the active flight plan routing to the FROM waypoint and then to the TO waypoint along the displayed leg or directly FROM aircraft present position TO the displayed waypoint (PPSN DIRECT), or from aircraft present position along the flight plan to a waypoint (PPSN VIA FPLN). The present position in this case is the position of the designated pilot's navigational solution.

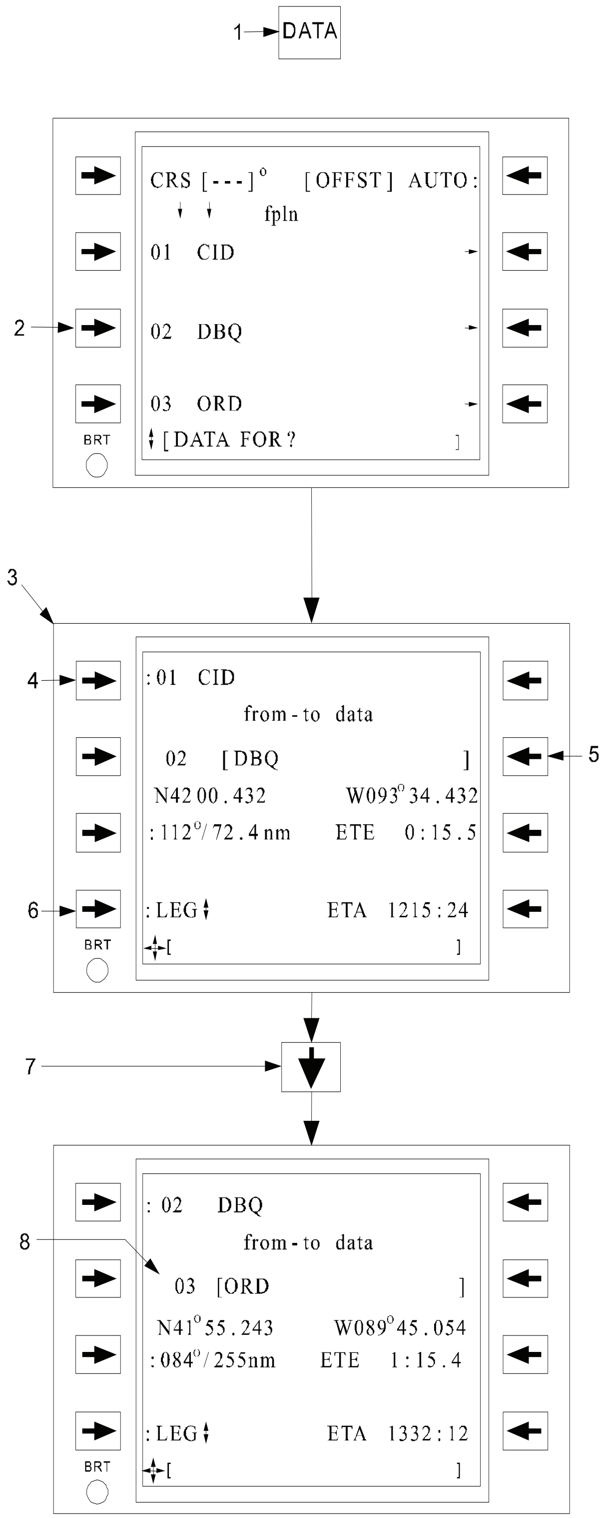


Figure 3B-103. Data Page Access and Leg or Waypoint Scrolling/Selection

Table 3B-71. Data Page Access and Leg or Waypoint Scrolling/Selection

NO.	DESCRIPTION/FUNCTION
1	Press **DATA** function key to display DATA FOR? in the scratchpad.
2	Access Data page for waypoint DBQ.
3	The Data page displays data for the FROM-TO pair of CID and DBQ waypoints.
4	Select between flight play **FROM** waypoint, **PPSN DIRECT**, or **PPSN VIA FPLN**.
5	Insert a non-flight plan waypoint.
6	Select either waypoint **WPT** or **LEG** scrolling.
7	Scroll through flight plan legs (if LEG selected) or waypoints (if WPT selected).
8	Scrolling down displays data for the next waypoint in the flight plan.

If the FROM and/or TO waypoints are in the active flight plan, their corresponding flight plan waypoint numbers are displayed as shown in Figure 3B-104 and Table 3B-72.

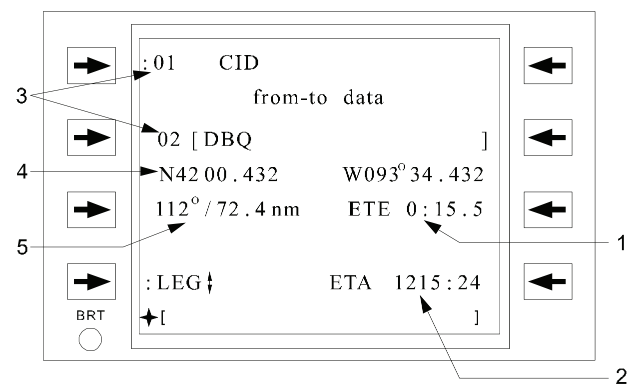


Figure 3B-104. Data Page Displayed Information

Table 3B-72. Data Page Displayed Information

NO.	DESCRIPTION/FUNCTION
1	ETE for displayed leg, direct segment, or along flight plan.
2	ETA using current TAS and wind or entered groundspeed.
3	Flight plan waypoint number.
4	Latitude-Longitude of TO waypoint.
5	FROM-TO bearing/distance or distance along flight plan.

If the FROM waypoint on the Data page is a flight plan waypoint and if a holding pattern or MFP is in the flight plan at or prior to that point, the ETA at the TO waypoint assumes the aircraft will depart the holding fix at the entered Expected Further Clearance (EFC) time or depart the MFP pattern fix at the Expected Time of Departure (ETD), if entered. Otherwise, no holding or pattern "on-station" loiter time is included in the ETA calculation.

When the FROM waypoint or PPSN DIRECT is selected, then the bearing and great circle distance between the FROM and TO waypoints are indicated on data line 3. Refer to Figures 3B-105 through 3B-109. When the PPSN VIA FPLN is selected, the along flight plan distance to the TO waypoint is indicated, Figure 3B-110.

The ETE and ETA are indicated on data lines 3 and 4, respectively. When the **FROM** waypoint is selected, the ETA is calculated from aircraft present position to the FROM waypoint, and then direct to the TO waypoint; and, the ETE is calculated between the FROM and TO waypoints, Figures 3B-105, 3B-106, and 3B-107. When **PPSN DIRECT** is selected, the ETE and ETA are calculated for a flight path directly between aircraft present position and the TO waypoint, Figures 3B-108 and 3B-109. When **PPSN VIA FPLN** is selected, the ETA and ETE are calculated along the flight plan from present position, Figure 3B-110.

The ETA and ETE are calculated one of two ways, depending on the TO waypoint. If the TO waypoint is the active waypoint, direct to a future flight plan waypoint (PPSN DIRECT), or a non-flight plan waypoint, the current wind and TAS are used to calculate the ETA and ETE. If the TO waypoint is a future or history waypoint, the intervening leg winds are used to calculate the ETA and ETE. When the aircraft is not airborne, the groundspeed entered on the Navigation Configuration page is used for ETA and ETE calculations.

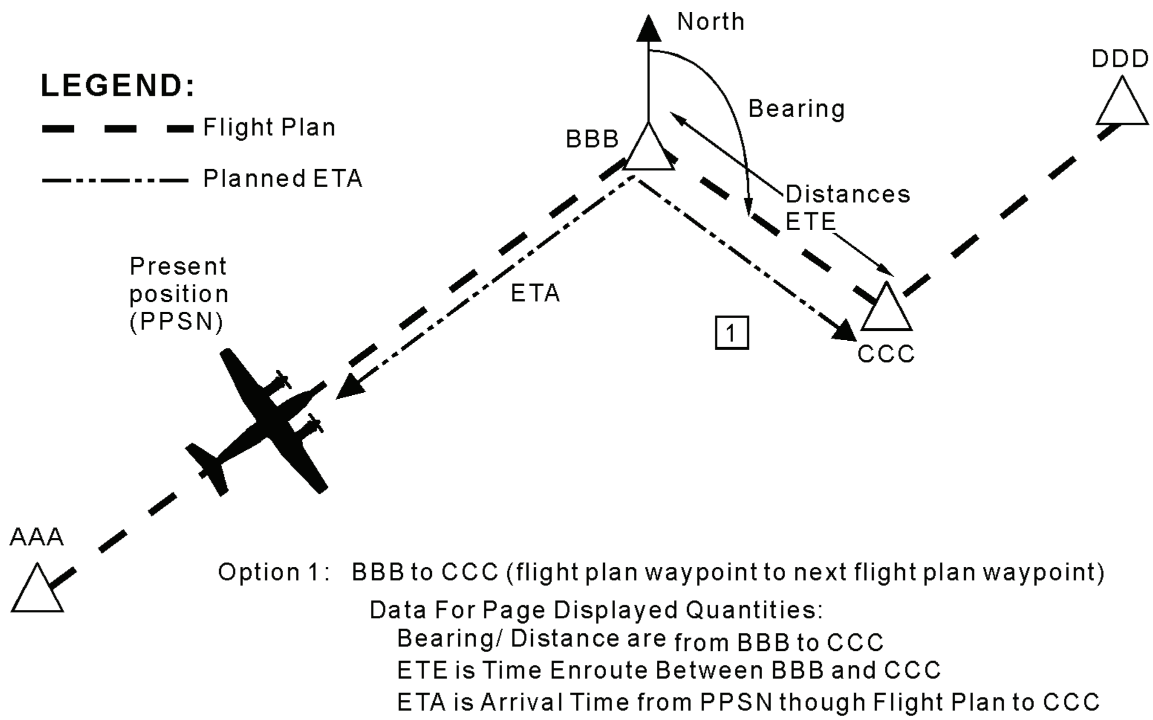
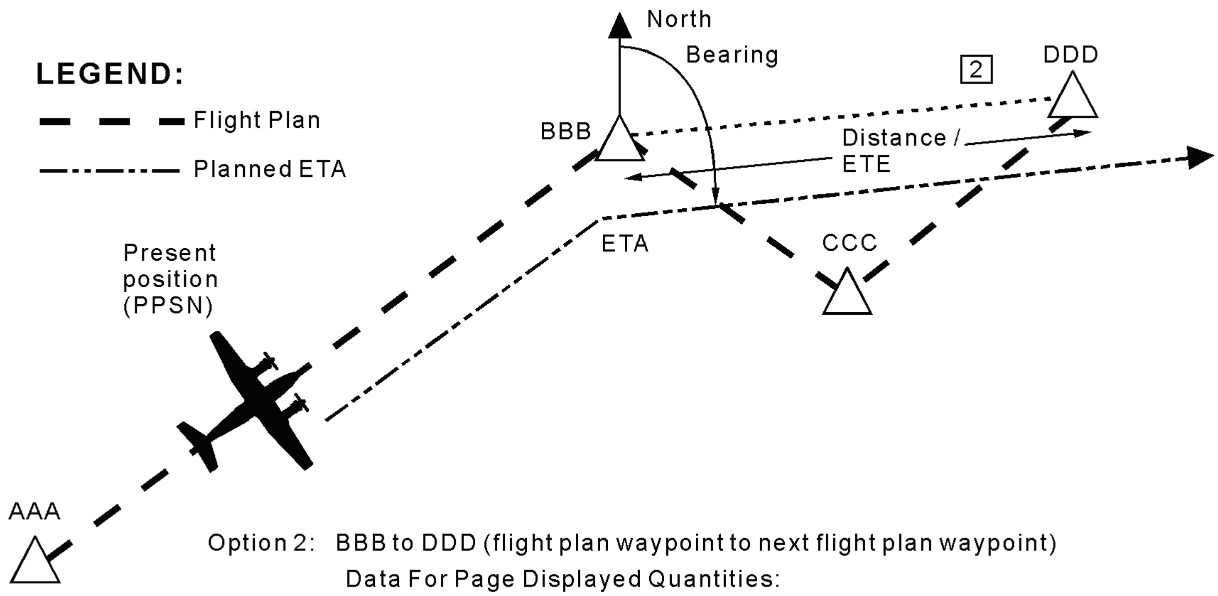


Figure 3B-105. Data For Option 1



Option 2: BBB to DDD (flight plan waypoint to next flight plan waypoint)

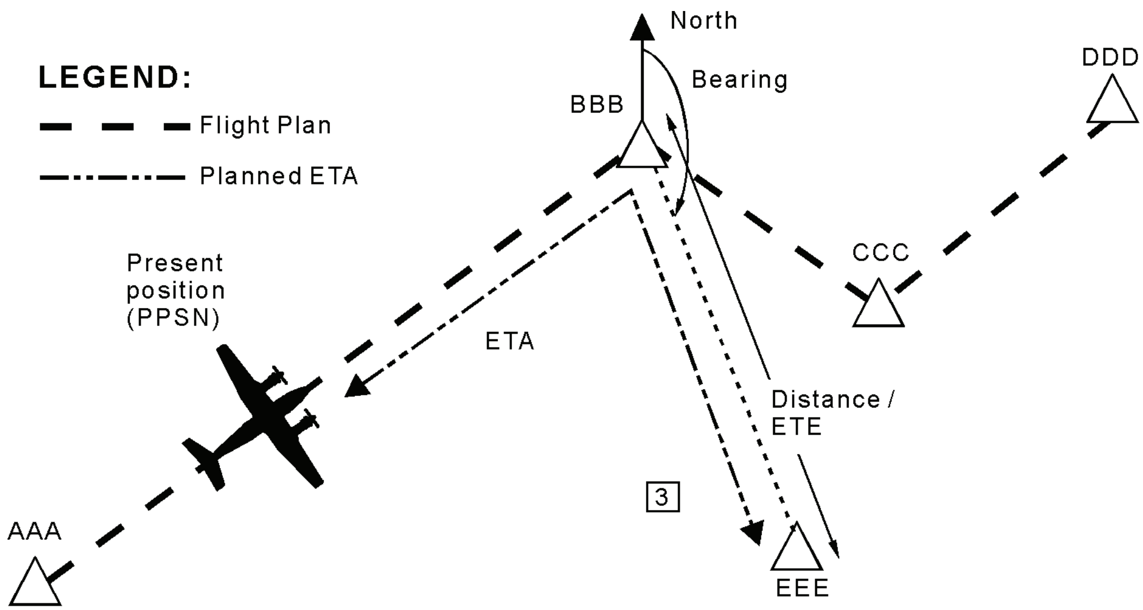
Data For Page Displayed Quantities:

Bearing/ Distance are from BBB to DDD Direct

ETE is Time Enroute Between BBB and DDD Direct

ETA is Arrival Time from PPSN though Flight Plan to BBB then Direct to DDD

Figure 3B-106. Data For Option 2



Option 3: BBB to EEE (flight plan waypoint to non-flight plan waypoint)

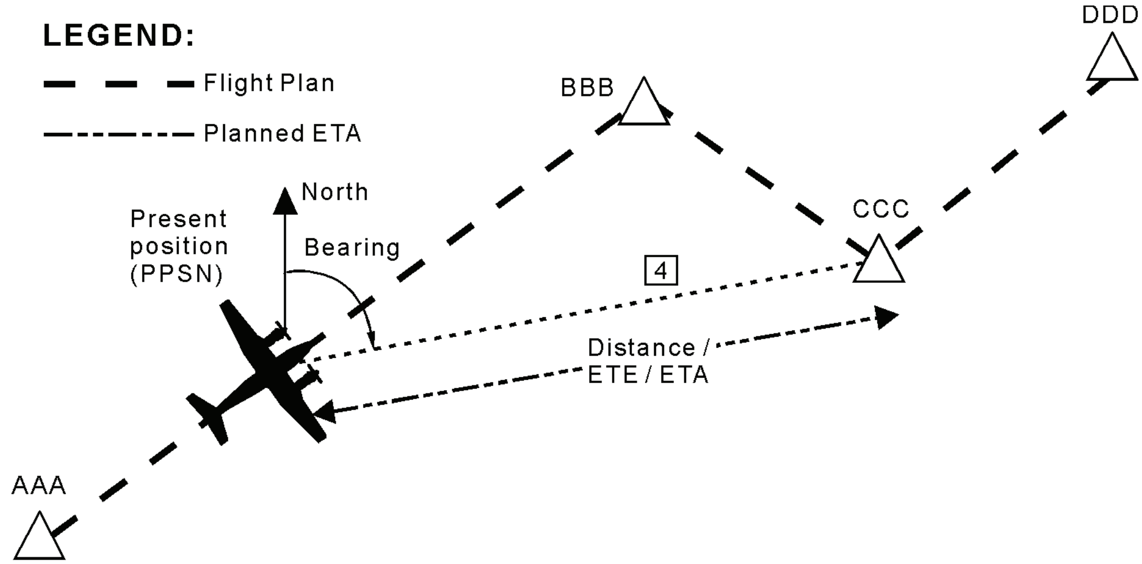
Data For Page Displayed Quantities:

Bearing/ Distance are from BBB to EEE Direct

ETE is Time Enroute Between BBB and EEE Direct

ETA is Arrival Time from PPSN though Flight Plan to BBB then Direct to EEE

Figure 3B-107. Data For Option 3



Option 4: PPSN DIRECT to CCC (present position direct to flight plan waypoint)

Data For Page Displayed Quantities:

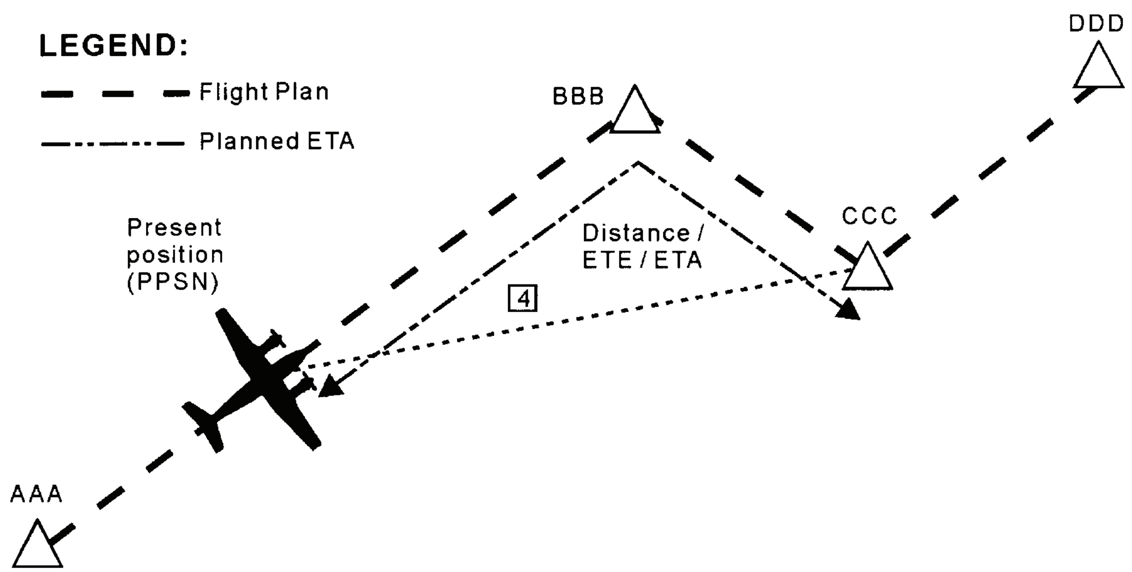
Bearing/ Distance are from PPSN Direct to CCC

ETE is Time Enroute from PPSN Direct to CCC

ETA is Arrival Time from PPSN Direct to CCC

12-295

Figure 3B-108. Data For Option 4



Option 4: PPSN VIA FPLN to CCC (present position through flight plan to flight plan waypoint)

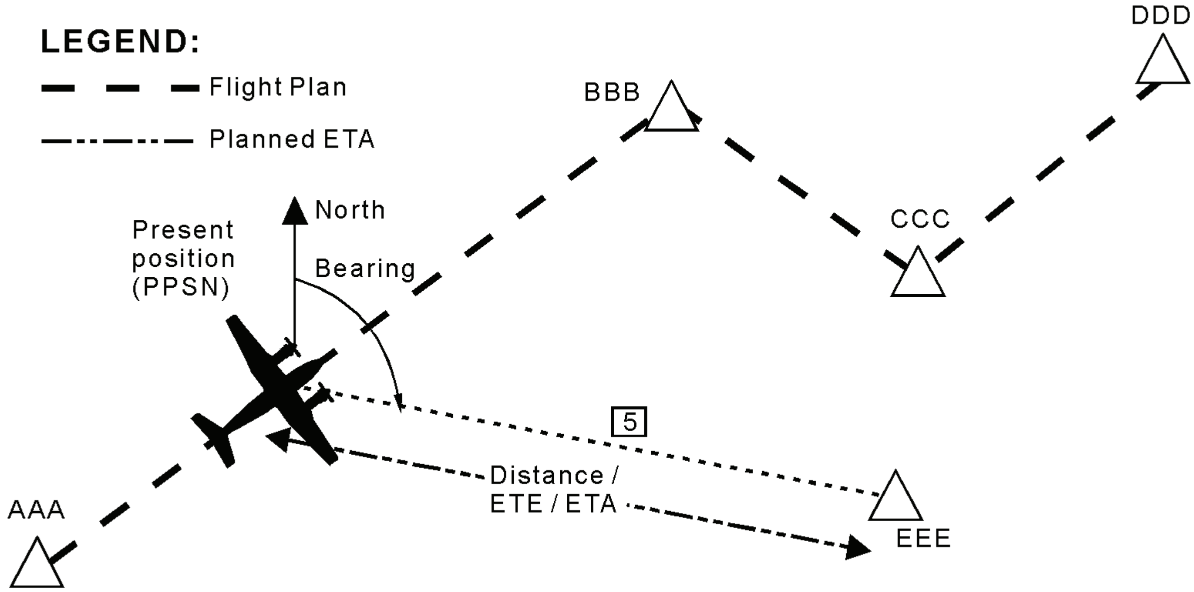
Data For Page Displayed Quantities:

Distance is total distance from PPSN through Flight Plan to CCC

ETE is Time Enroute from PPSN through Flight Plan to CCC

ETA is Arrival Time from PPSN through Flight Plan To CCC

Figure 3B-109. Data For Option 4 (Via Flight Plan)



Option 5: PPSN DIRECT to EEE (present position to non-flight plan waypoint)

Data For Page Displayed Quantities:

Bearing/ Distance are from PPSN Direct to EEE
ETE is Time Enroute from PPSN Direct to EEE
ETA is Arrival Time from PPSN Direct to EEE

Figure 3B-110. Data For Option 5

(2) Selection and Display of Waypoint Identifier Data. To view the ICAO database information for identifier–referenced waypoints, select or enter the waypoint identifier or leg pair on the Data page. Then press one of the ← or → arrow function keys to scroll to the corresponding Ident Data page for the TO waypoint. Refer to Figure 3B-111 and Table 3B-73.

If the TO waypoint on the Data page selected leg is an ICAO identifier-referenced waypoint (including identifier/bearing/distance waypoints), its corresponding database information is presented. The waypoint type, identifier, station frequency/ TACAN channel (if applicable), and elevation MSL are displayed. If the waypoint is a nav aid with a station declination, it is displayed as DCL. If the waypoint is not a nav aid with a station declination, the FMS-800 computes the magnetic variation for that location and displays MVAR.

r. GPS Integrated Navigation.

(1) Navigational System Overview. The GPS navigational source used for the pilot's steering solution is displayed on the pilot lateral steering page, Figure 3B-112 and Table 3B-74.

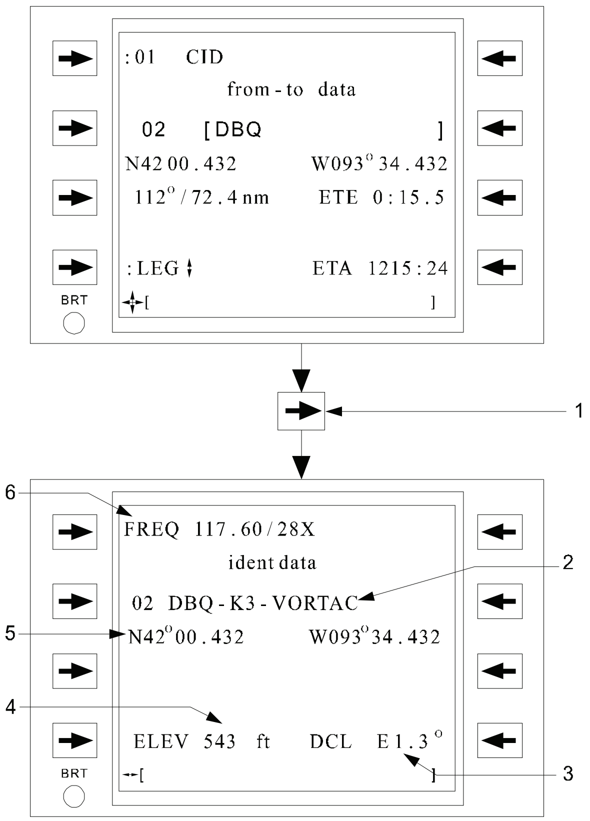


Figure 3B-111. Ident Data Page Access and Displayed Information

Table 3B-73. Ident Data Page Access and Displayed Information

NO.	DESCRIPTION/FUNCTION
1	Scroll horizontally with scroll function key.
2	ICAO identifier with country code, and waypoint type (if applicable).
3	Waypoint Station declination or magnetic variation.
4	Waypoint elevation MSL.
5	Waypoint latitude/longitude.
6	Station frequency and/or TACAN channel.

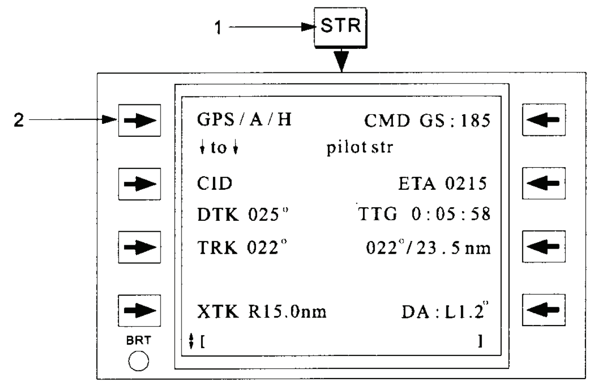


Figure 3B-112. Pilot Lateral Steer Pages

Table 3B-74. Pilot Lateral Steer Pages

NO.	DESCRIPTION/FUNCTION
1	Pressing the **STR** function key will access the last viewed steering page. Vertically scroll if necessary to access the pilot lateral steer page.
2	Navigation Source.

(2) Position, Track, And Air Data Displays. The navigation solution for the GPS navigation source is displayed on the pilot position page as shown in Figure 3B-113 and Table 3B-75. The true airspeed and SAT shown on this page comes from the Air Data Computer (ADC).

The wind vector is displayed as either a current wind vector, crosswind component, or head/tail wind component. For the headwind/ tailwind component, a ↑ will indicate a tail wind and a ↓ will indicate a headwind. For the crosswind component, a → will indicate a left crosswind with the magnitude to the right of the arrow, and ← will indicate a right crosswind with the magnitude to the left of the arrow.

When the groundspeed and true airspeed are invalid, the numeric display for the wind will be dashed and the headwind/tailwind and crosswind data will be removed.

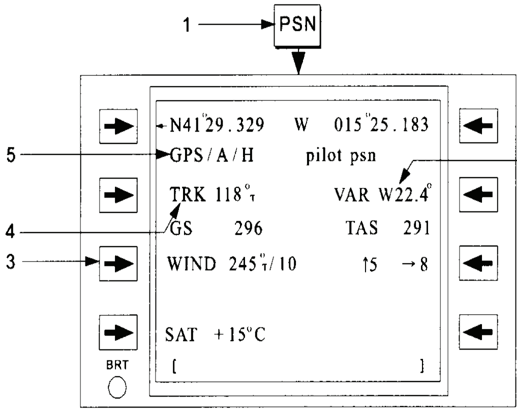


Figure 3B-113. Pilot Position Page

Table 3B-75. Pilot Position Page (Continued)

NO.	DESCRIPTION/FUNCTION
1	Pressing **PSN** function key will access the pilot position page.
2	Computed magnetic variation at present position.
3	This line select key is non-operational if a computed wind speed is available or if the FMS is displaying an INU wind. Otherwise, the following three actions will occur: 1. Selection with a valid entry in the scratchpad will enter the wind. 2. Selection with an empty scratchpad will copy the wind entry into the scratchpad. 3. Selection with a - in the scratchpad will set the wind speed to 0 knots.

Table 3B-75. Pilot Position Page (Continued)

NO.	DESCRIPTION/FUNCTION
4	Track displays mag track.
5	Navigation source selected on pilot/copilot lateral steer pages.

The status and validity of the navigational source are indicated on the title lines of the Pilot Position pages. Table 3B-76 lists the indications and their meanings. Any automatic downgrading of the navigation source is annunciated on the CDU.

A √nav error annunciation and/or the HSI flag are provided when either the status of the selected navigation sensors has degraded or the 95% error exceeds a threshold determined by the current flight plan guidance mode; EN ROUTE, TERMINAL, or APPROACH. When these alerts are provided, examine the current state of the GPS navigation solution and compare the solution to the other on-board navigation systems. If necessary, select a different navigation sensor to provide continued guidance of the aircraft.

(a) GPS Display. The GPS INAV page shows the present position output from the GPS receiver. It also shows a 95% error figure of merit for the probable system accuracy, given the current GPS satellite navigational quality (satellite tracking state and geometry) as shown in Figure 3B-114 and Table 3B-77. If GPS/A/H is indicated on the title line, the FMS-800 is using airspeed and heading sensor inputs to smooth the GPS data. This is required to have a valid bank (roll) command output to the flight director and autopilot.

Table 3B-76. Display of Navigation Mode on Position Pages

SELECTED NAV SOLUTION	DISPLAYED MODE	CONDITIONS FOR DISPLAY
GPS	GPS/A/H	GPS navigation data is smoothed with airspeed and heading.
GPS	GPS/ - /H	GPS navigation data is being smoothed with GPS groundspeed and heading.
GPS	GPS/ - / -	GPS is not being smoothed with airspeed and heading data.
GPS	- - - /A/H	GPS is invalid; FMS is dead reckoning with airspeed and heading data.
MODEL	MODEL	The model aircraft function is providing the navigation solution. This function is available only while on the ground.

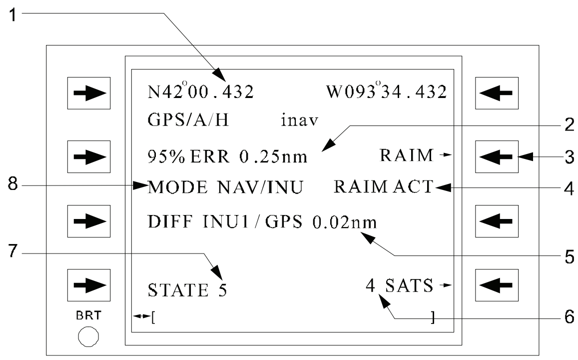


Figure 3B-114. GPS Integrated Navigation Page

Table 3B-77. GPS Integrated Navigation Page

NO.	DESCRIPTION/FUNCTION
1	Indicates present GPS position.
2	95% probably position error.
3	Selects GPS RAIM page.
4	Indicates the current RAIM Status.
5	Difference from designated pilot's source.
6	Number of GPS satellites tracked.
7	The GPS receiver state.
8	The current GPS tracking/aiding mode.

The MODE indicates the current GPS receiver tracking/aiding mode of INIT, TEST, or NAV/PVA.

The STATE indicates the lowest tracking state of the four primary satellite tracking channels: STATE 1 is acquisition, STATE 3 is code track only (in jamming), and STATE 5 is code and carrier lock (no jamming).

The number of satellites being tracked for primary navigational purposes is displayed. Normally four satellites are tracked to provide a fully determined position (a four dimensional position requires four satellites). Less than four may result in GPS data being invalid.

(b) GPS Satellite Data. The FMS-800 provides the crew access to the page displaying the individual channel/satellite tracking status for the GPS receiver. Selecting the **SATS** line select key on the GPS INAV page will access this page. Refer to Figure 3B-115 and Table 3B-78.

The possible state displays are as follows:

1, 2	S	Search
4, 6	T	Tracked
3	I	Interference
5	D	Tracked with data
7	R	Recovery

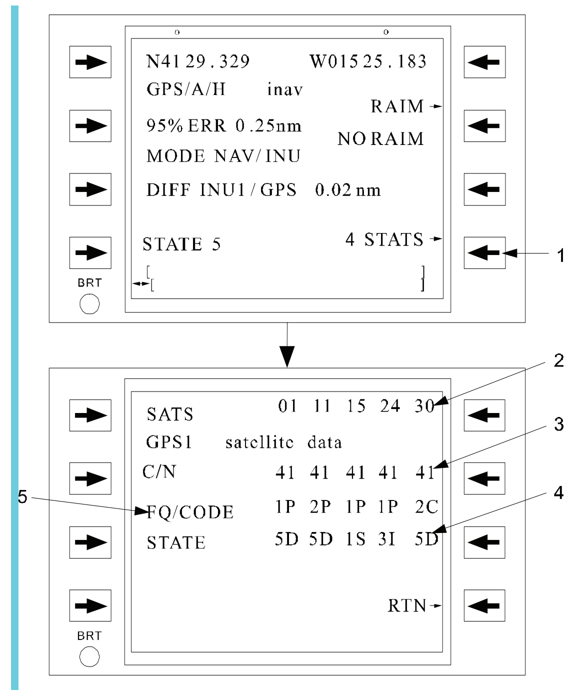


Figure 3B-115. GPS Satellite Data

Table 3B-78. GPS Satellite Data

NO.	DESCRIPTION/FUNCTION
1	Pressing line select key **SATS** will access the channel/satellite tracking status page.
2	Indicates satellite vehicles in track or search.
3	Indicates the carrier to noise ratio of satellite signal.
4	Indicates tracking state of satellite channel.
5	The frequency and code in track.

The GPS satellite data page provides information regarding the current tracking state of each GPS receiver channel. This page also provides information on which satellite is currently being tracked, current carrier to noise ratio for the incoming signal, frequency and code types being tracked, and the current state of receiver tracking.

(c) GPS Receiver Autonomous Integrity Monitoring (RAIM). The FMS-800 provides the crew access to a page providing the RAIM control/predictive RAIM for the active GPS receiver. Selecting the RAIM line key on the GPS INAV page, Figure 3B-116 and Table 3B-79 accesses these pages.

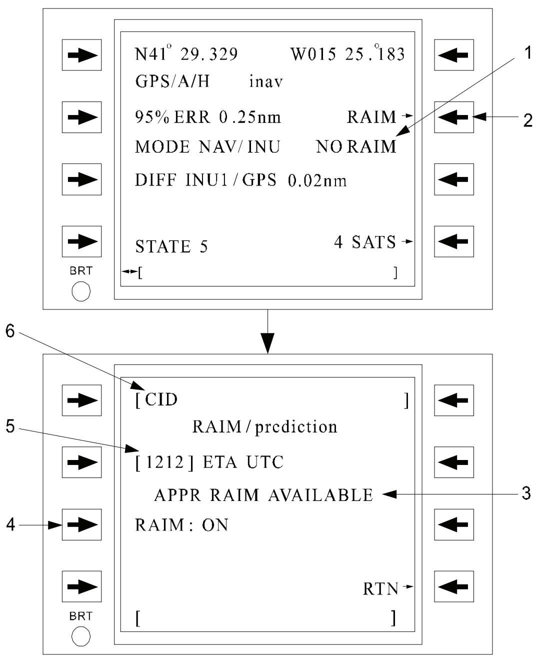


Figure 3B-116. GPS RAIM

Table 3B-79. GPS RAIM

NO.	DESCRIPTION/FUNCTION
1	Indicates the current state of active RAIM solution.
2	Pressing line select key **RAIM** will access the RAIM/prediction page.
3	Expected state of RAIM availability at destination.
4	Select to disable nuisance RAIM annunciations.
5	Indicates Estimated Time of Arrival at destination.
6	Destination of interest for RAIM.

The FMS-800 provides an active RAIM solution at present position. By tracking GPS satellite state-of-health and orbital geometry, the FMS-800 is capable of determining when the GPS navigation solution is degraded or suspect due to satellite failures. If the GPS receiver is unable to provide a RAIM solution due to satellite tracking problems or problems with the satellite constellation geometry, a No RAIM annunciation is shown to inform the crew of the absence of RAIM protection. During a NO RAIM period, the GPS navigation solution may be acceptable but the integrity of that solution will be indeterminate. During normal GPS navigation with an active RAIM solution, if the GPS receiver determines that there is an inconsistency in the GPS navigation solution, a RAIM alert will be provided to inform the crew of a degraded GPS navigation solution. When an alert is indicated, the crew should compare the GPS based navigation solution with other available sensors (INU, TACAN, and VOR/DME) to ensure the GPS navigational accuracy is acceptable. If unacceptable, select a non-GPS based navigation solution on the lateral steer page, Figure 3B-116, until the integrity of the GPS navigation solution is restored.

The current state of the GPS RAIM solution is provided on the Primary GPS INAV page as follows:

1. NO RAIM when RAIM processing is unavailable.
2. RAIM ACT when RAIM processing is actively performing integrity checks.
3. RAIM WRN when RAIM has detected an inconsistency.

The line select key next to RAIM on the RAIM/prediction page will enable or disable the RAIM annunciations. When **OFF** is selected, RAIM annunciations are inhibited and the pilot advisories regarding GPS integrity performance will be only available on the GPS INAV page. RAIM annunciations should only be disabled if a failure is suspected in the GPS receiver causing nuisance annunciations. Annunciations will be automatically re-enabled whenever the FMS is powered on or enters the terminal area.

To request the availability of approach RAIM at a destination airport, first enter the identifier of the airport in the top line of the RAIM/PREDICTION page. Then enter the Expected Time of Arrival (ETA) in UTC. After performing the predicted calculation, the FMS-800 will display the availability of approach RAIM on the page information line. This availability applies to a period from 15 minutes prior to the entered ETA until 15 minutes after the ETA. A predictive RAIM solution only provides an indication of the availability of RAIM protection that is expected at the destination based on the current orbital characteristics of the GPS constellation. It does not provide an actual integrity determination at the desired location.

(d) Selective Availability/Antispoofing Control Page. The FMS-800 provides access to a GPS Selective Availability/Antispoofing control page. From the IDX page, select **SA/AS** to access the SA/AS control. From this page, the current status of GPS receiver keying is displayed, with two selections for mission duration and SA/AS mode selection. GPS mission duration is entered in days and defines the expected length of an aircraft mission requiring GPS keys. If more keys are loaded into the GPS receiver than are needed, the entry of duration will zeroize the excess keys. If duration exceeds the availability of keys, the FMS will annunciate the need to load additional keys. The duration displayed on the page is the current duration of the keys loaded into the GPS receiver.

NOTE

When the GPS receiver is configured for Y-Only mode and no keys are loaded into the GPS receiver to decrypt the satellite telemetry, RAIM processing is disabled and RAIM protection will be unavailable.

The SA/AS mode selection allows the operator to select between a MIXED mode satellite constellation with both keyed and unkeyed satellite transmissions, or restrict the receiver to Y-only keyed satellites, excluding the use of satellites not currently keyed for P(Y) code encryption.

s. Navigation Radio Information.

(1) Navigation Radio Information Overview. The FMS-800 provides navigation radio information upon valid entry of an airport identifier. The crew may access the Navigation Information Radio page via the NAV function key on the CDU. Refer to Figure 3B-117 and Table 3B-80.

Selection of the airport identifier, with a valid airport ID in the scratchpad and loaded on the data cartridge, will load the airport navigation information of that airport from the data cartridge. The entered ID will also be entered on the Communications Radio page.

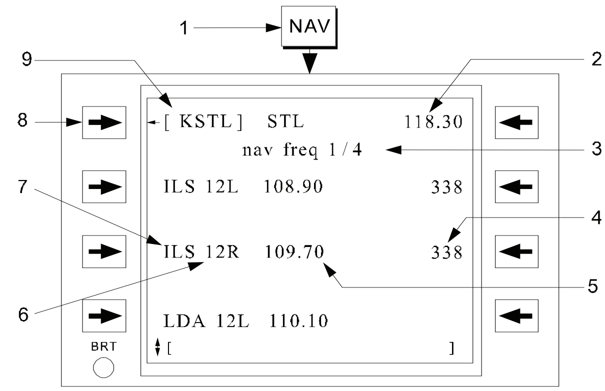


Figure 3B-117. Navigation Radio Information Page

Table 3B-80. Navigation Radio Information Page

NO.	DESCRIPTION/FUNCTION
1	Pressing the function key **NAV** will access the Navigation Radio Information page.
2	Indicates the frequency of the recommended airport navigation aid.
3	Indicates page 1 of 4.
4	The NDB frequency.
5	The frequency of the navigation aid.
6	The runway ID.
7	Type of navigation aid.
8	When a valid airport ID is in the scratchpad, LS1 retrieves the navigation information for that ID from the data cartridge.
9	The airport ID.

(2) Navigation Radio Information Page Functionality. Data lines, 2 through 4, displays the following data:

1. The name of the approach which includes the type of nav aid and the runway. The possible types of nav aids are ILS, LOC, BC (Back Course) for an LOC, BC, LDA (Localizer type Directional Aid), or SDF (Simplified Directional Facility).

2. The frequency of the nav aid.

3. The NDB frequency associated with the approach, if any. The NDB frequency is the frequency of a compass locator at the outer, middle, or inner marker beacons.

(3) Vertical Scrolling. Vertical scrolling has the following characteristics:

1. Will access additional approach frequency data for other runways and wrap around in both directions if more than one page of information exists.

2. Data line 1 will remain fixed during scrolling.

The frequencies will be displayed in groups of three per page. A maximum of 12 frequencies or 4 pages may be accessed.

t. Communication Radio Control.

(1) Communication Radio Control Overview. The FMS-800 provides control of the following functions from the CDU, for the ARC-210 V/UHF radio:

1. V/UHF radio mode selection.

2. V/UHF radio squelch, bandwidth, tone, and modulation control.

3. V/UHF radio scanning operation.

4. HAVE QUICK I/II function control, including MWOD and FMT list selection, time synchronization, date entry, MWOD verification, and SINCGARS control functions.

In addition, the Flight Displays provide heads up control and display of the communication radios.

Communication radio frequency selection is available via the communication page by selecting the COM function key of the CDU. The V/UHF control pages provide the basic radio control features. Specialized pages such as the V/UHF HAVE QUICK II setup pages and SINCGARS control pages are also available.

If the FMS-800 cannot interface with a radio for any reason (i.e., LRU failure, data bus failure, etc.), a check mark (√) will be displayed to the left of the title line of all pages corresponding to that radio. A √ will also be displayed on the communication pages adjacent to the preset number of the LRU.

Power to the communication radio is controlled via the power pages.

The FMS-800 also has provisions for an external, crew activated emergency mode switch for setting all communication radios to emergency frequencies, if installed on the aircraft.

(2) V/UHF Radio Control.

(a) V/UHF Frequency Selection. The crew may tune the V/UHF radios by frequency, callsign, maritime channel, or preset number. Frequency tuning is performed directly on the Communications page by entering the desired frequency in the scratchpad and pressing the channel selection line select key. Refer to Figure 3B-118 and Table 3B-81. A valid frequency is entered as two to three digits followed by up to four decimals, followed by A, AM, F, or FM to define the modulation type. An M is displayed as the preset number to indicate the frequency was entered manually. Possible ways of tuning the communication radio are with manual frequency selections (including frequencies, net identifiers, or maritime channel entries), preset callsign entry, preset number selection, or airport frequency selection.

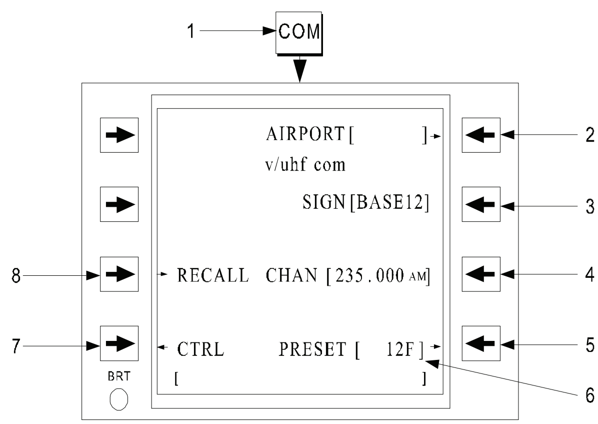


Figure 3B-118. Frequency Control, Communication Page

Table 3B-81. Frequency Control, Communication Page

NO.	DESCRIPTION/FUNCTION
1	Pressing the function key **COM** will access the communication page.
2	Enter airport identifier and access the V/UHF airport frequency page.

Table 3B-81. Frequency Control, Communication Page (Continued)

NO.	DESCRIPTION/FUNCTION
3	Enter preset callsign or display airport callsign.
4	Enter frequency or channel.
5	To access preset list.
6	Indicates preset number.
7	To access the V/UHF control page.
8	Recall frequency to last tuned.

The crew may also tune a V/UHF frequency using the scratchpad of any CDU page and the Quicktune switch, located on the pilot and copilot control yoke. Enter any of the following into the CDU scratchpad and press the Quicktune switch to tune the radio:

1. A valid V/UHF frequency, channel, or net identifier.

2. A valid callsign for a V/UHF frequency located in the preset list. This does NOT include airport frequency callsigns.

When the crew changes the radio frequency, the FMS-800 saves the previous frequency. To return to the previous frequency, press the **RECALL** line select key or press the Quicktune push button with no CDU scratchpad entry.

(b) Preset Frequency Tuning. Preset frequencies can be entered manually on the V/UHF preset pages, which can be stored on or loaded from a data cartridge. The FMS-800 maintains one list of 52 presets for the V/UHF radio. To select a preset frequency, either enter the preset number and press line select key 4R on the Communications page, access the V/UHF presets pages and select one of the 52 available presets, or enter the preset callsign and press the appropriate line select key. Once the preset is selected, the preset number is displayed in the preset number field on the Communication page along with the associated callsign. Figure 3B-119 and Table 3B-82 shows how to use the V/UHF presets pages.

To tune the radio to a preset callsign, enter the callsign and press the appropriate line select key on the Communication page. The FMS-800 will search the preset list for that callsign and tune the radio to that frequency, if found. If the callsign is not found, SIGN NOT FOUND will be displayed.

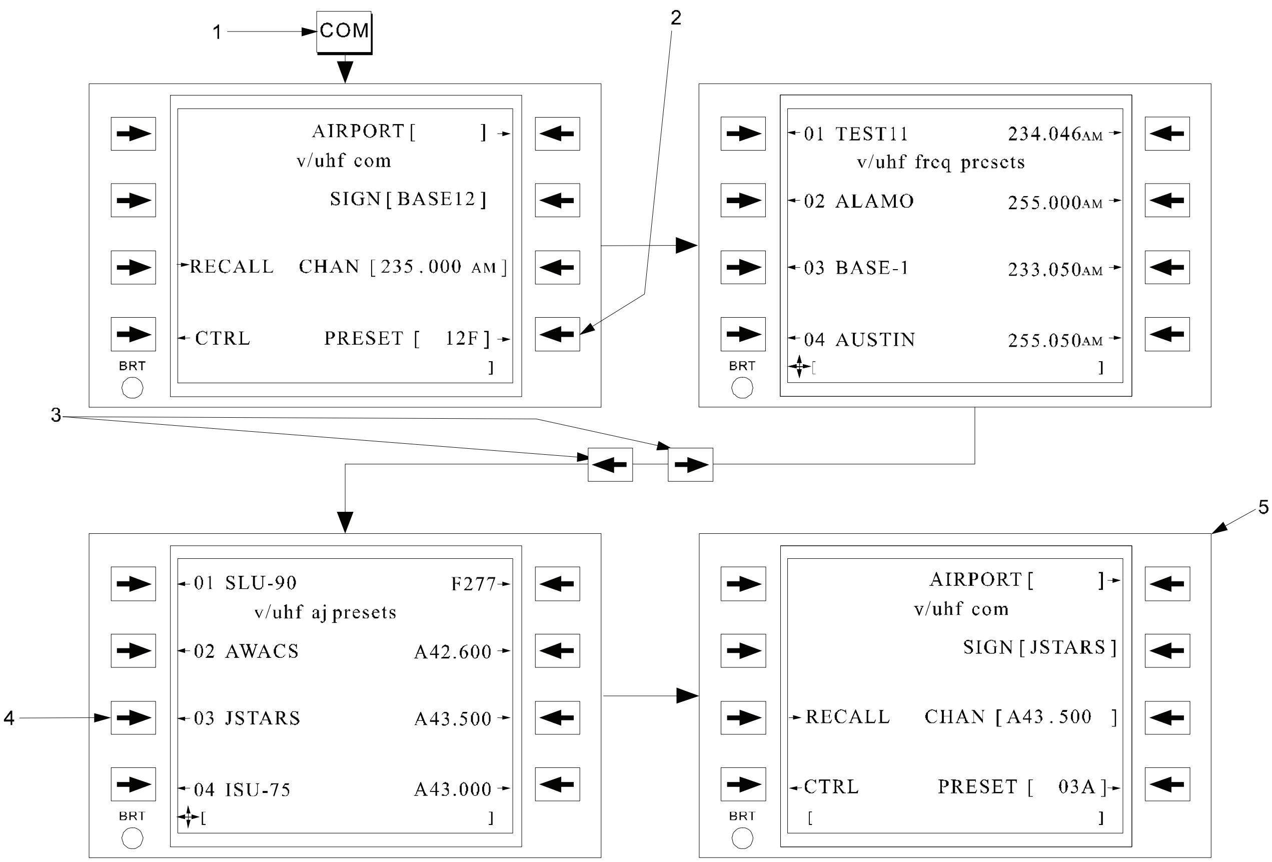


Figure 3B-119. Preset Page Access and Usage

Table 3B-82. Preset Page Access and Usage

NO.	DESCRIPTION/FUNCTION
1	Pressing **COM** function key will access the communication page.
2	Pressing line select key **PRESET** will access the V/UHF presets page.
3	Laterally scroll between the frequency presets and the V/UHF anti-jam presets pages.
4	To select a new preset number.
5	The communication page returns with the selected preset displayed.

To enter the preset frequencies into the preset lists, access the Preset pages from the Communication page and laterally scroll to the Frequency Preset or Anti-jam Preset page. Refer to Figure 3B-120 and Table 3B-83. Access the Preset page by selecting the right line select key corresponding to the preset list item, and assign a frequency and callsign to the preset list item.

On the last page of the Anti-jam presets, select **UPDT CDU AJ PRESETS** to reload ARC-210 Anti-jam presets into the CDU to align radio and CDU preset lists.

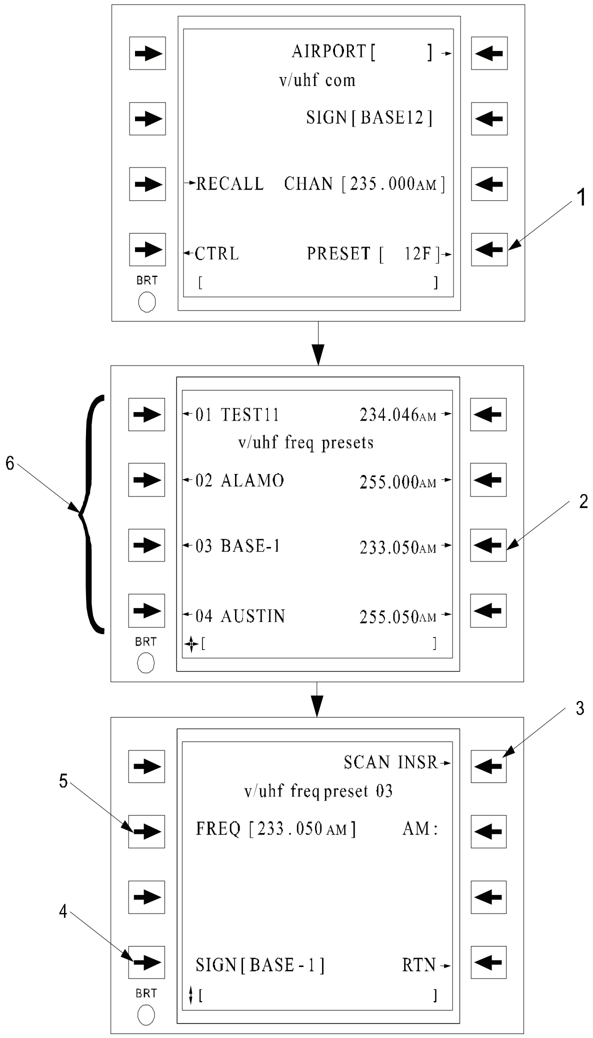


Figure 3B-120. Frequency and Anti-jam Preset Page Access and Usage

Table 3B-83. Frequency and Antijam Preset Page Access and Usage

NO.	DESCRIPTION/FUNCTION
1	To access the presets page(s) and laterally scroll to the desired preset list page.
2	To access frequency preset page to define preset.
3	Select to insert into scan list.
4	Select callsign for preset frequency.
5	Select frequency and modulation for preset.
6	Select to tune to preset and return to communication page.

(c) Maritime Channels. To use a maritime channel enter **M** and the channel number. If the transmit frequency is to be the coast frequency associated with that channel insert a **C** after the channel number. If C is not entered, the ship frequency will be used as the transmit frequency.

To switch radio tuning between ship and coastal frequencies, enter an **S** (ship) or **C** (coast) into the CDU scratchpad and press the **CHAN** line select key.

(d) V/UHF Scan Function. The FMS-800/ARC-210 provide an ability to continuously scan up to four communication frequencies for incoming signals. To enable the ARC-210 scan function, access the V/UHF control page and toggle the SCAN mode to **ON**. SCAN: will replace the callsign field of the communication page and the frequency field will display the scan frequency. The radio will progressively scan through each of the four scan frequencies entered on the V/UHF scan list page. When the radio detects a signal on one of the scan frequencies, RECV: will be displayed as long as a signal is detected. The frequency on which the signal was detected will be displayed in the frequency field. To lock onto that frequency, press the **RECV** line select key to toggle the channel to LOCKX. Repeat pressing this line select key to recall former locked scan frequencies. Up to three scan frequencies can be recalled as locked frequencies. When the oldest locked frequency is displayed, press the same line select key again to return the radio to scan mode.

To enter the frequencies into the scan list, access the preset pages from the Communication page and laterally scroll to the V/UHF Scan List page. Refer to Figure 3B-121 and Table 3B-84. The first scan frequency is the scan transmit frequency, i.e., the frequency on which the radio will transmit, if keyed while scanning. Access the Scan Preset page by selecting the right line select key corresponding to the scan list item; and, like on the Frequency Preset page, assign a frequency and callsign to the scan list item. On the Frequency Presets pages, transfer presets from the V/UHF Presets pages to the scan list by accessing the V/UHF Preset xx page of the desired preset and press the **SCAN INSR** line select key. The V/UHF Scan List page will be displayed with INSERT PRESET AT? in the scratchpad. Press any of the four left line select keys to insert the frequency preset into the scan list.

(e) V/UHF Airport Frequency Selection. To tune the radio to airport frequencies stored on the data cartridge access the V/UHF Airport Frequency page. The V/UHF Airport Frequency page maybe accessed from the Communication page by entering a valid airport identifier and then pressing the line select

key 1R Figure 3B-122 and Table 3B-85. With a valid airport identifier displayed at line select key 1R, press this key to access the communication radio frequencies associated with that airport.

Line select keys 1L through 4L on the Airport Frequency page will select the corresponding airport frequency and tune the radio to the frequency or channel that was selected. The currently tuned frequency will be indicated with an * instead of an → adjacent to the line select key.

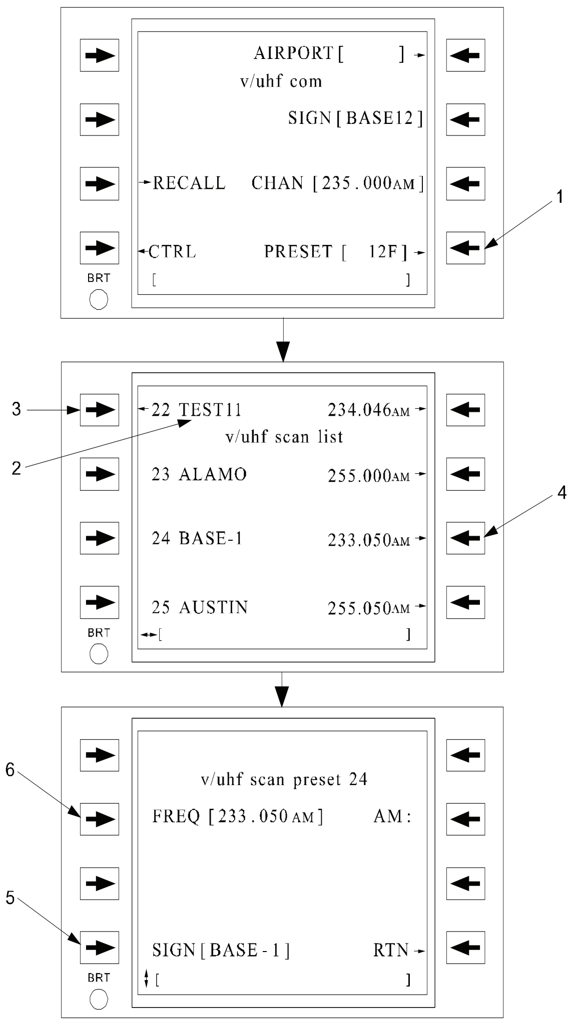


Figure 3B-121. Scan Preset Page Access and Usage

Table 3B-84. Scan Preset Page Access and Usage

NO.	DESCRIPTION/FUNCTION
1	Press line select key to access the presets page(s) and laterally scroll to the scan list page.
2	Indicates first scan list item used when push-to-talk is pressed during scan.
3	To activate scan function and return to communication page.
4	Press line select key to access scan preset page to define.
5	Select callsign for scan frequency.
6	Select frequency and modulation for scan.

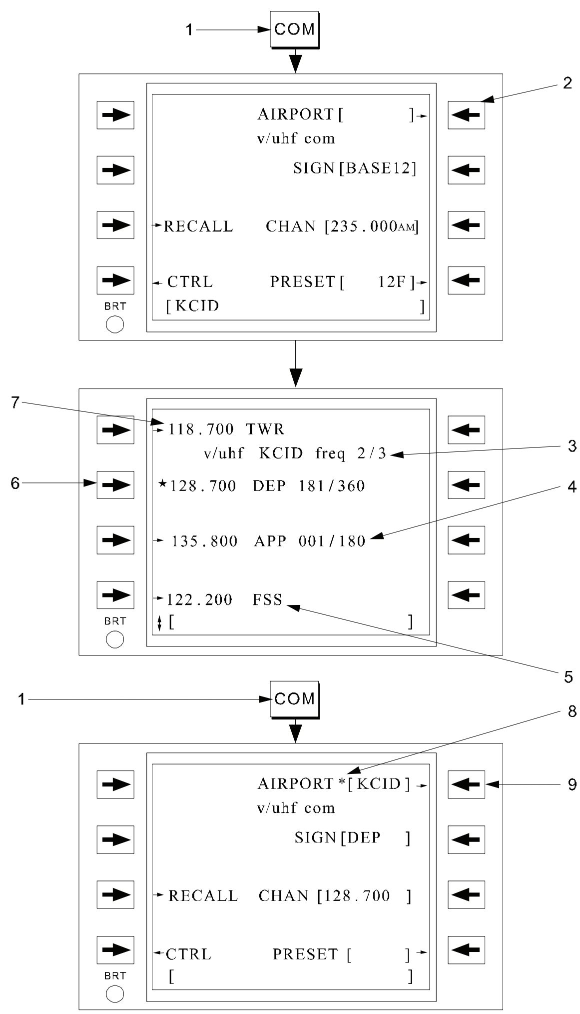


Figure 3B-122. Tuning to Airport Frequencies

Table 3B-85. Tuning to Airport Frequencies

NO.	DESCRIPTION/FUNCTION
1	Pressing function key **COM** will access the communication page.
2	Enter airport to access airport frequency.
3	Indicates page 2 of 3. Scroll vertically to access additional pages.
4	Sectorization.
5	Communication type.
6	Select desired airport frequency.
7	Airport frequencies.
8	An * indicates airport frequency is currently tuned.
9	Access airport frequencies for given airport.

Vertical scrolling will access additional V/UHF Airport Frequency pages. The scrolling wraps around if more than one page exists.

Data Lines 1 through 4 will display the following airport frequency information:

1. The V/UHF frequency.

2. The 3 or 4-character communication type (ATI, CPT, etc.).

3. The sectorization data (if any).

(f) V/UHF Radio Mode Selection. To select the V/UHF radio mode, toggle the **MODE** line select key on the V/UHF control page Figure 3B-123 and Table 3B-86. The possible selections are: Transmit/Receive (TR), transmit/receive with the independent guard receiver activated (TR/G), UHF guard (GD243), and VHF guard (GD121). In UHF guard mode, the FMS-800 tunes the V/UHF transmitter/receiver to 243.000 MHz and deactivates the independent guard receiver. In VHF guard mode, the FMS-800 tunes the V/UHF transmitter/receiver to 121.500 MHz and deactivates the independent guard receiver. When in either of the guard modes, the Communication page displays the guard frequencies and GUARD for the callsign.

(g) V/UHF Radio Squelch, Bandwidth, Tone, and Modulation Control. Control of the V/UHF radio squelch and tone is performed on the V/UHF Control page. Toggle the squelch **ON** or **OFF** by pressing the **SQL** line select key. Select headset beeps on and off by pressing the **BEEP** line select key.

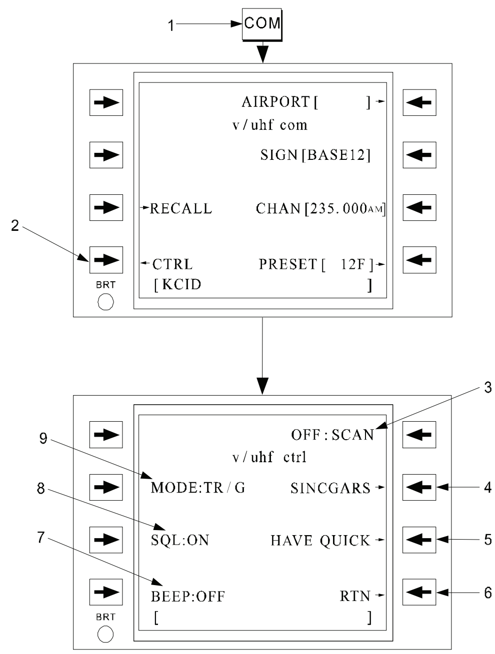


Figure 3B-123. V/UHF Control Functions

Table 3B-86. V/UHF Control Functions

NO.	DESCRIPTION/FUNCTION
1	Pressing the function key **COM** will access the communication page.
2	Press to access the V/UHF CTRL page.
3	Enable/disable frequency scanning.
4	Access SINCGARS control.
5	Access HAVE QUICK control.
6	Returns to the communication page.
7	Enable/disable audio beeps.
8	Enable/disable squelch.
9	Select radio modes: TR, TR/G, G243.0, or G121.5.

(h) V/UHF HAVE QUICK I/II Functionality. The FMS-800 order of operations for setting up the V/UHF radios for HAVE QUICK I/II functionality is as follows:

1. Load the MWOD and/or FMT lists into the V/UHF.

2. Load the desired date into the V/UHF (ensure a WOD is loaded for the entered date).

3. Synchronize time with the V/UHF radio.

4. Enter the desired net identifier on the Communication page.

(i) Loading Multiple Words of the Day (MWOD). An MWOD list can be created manually using the V/UHF MWOD Entry pages or loaded from a data cartridge. The FMS-800 maintains one MWOD list for V/UHF radios consisting of six Words Of the Day (WOD's). To load each WOD element into the MWOD list manually, access the MWOD Entry page as shown in Figure 3B-124 and Table 3B-87. To load the MWOD list into the V/UHF radio, press the **ENTER** line select key on the V/UHF MWOD Entry page. Entry of the MWOD list into the V/UHF radio will load the WOD's for the selected day into the V/UHF radio. Up to 6 days of MWOD lists may be transferred into the V/UHF radio. To enter additional daily MWOD's, enter the selected date for the MWOD, and load WOD's as described above. When an MWOD is successfully loaded into the V/UHF radio, the radio will acknowledge the load with one short tone following each WOD loaded, and will end with two short headset beeps.

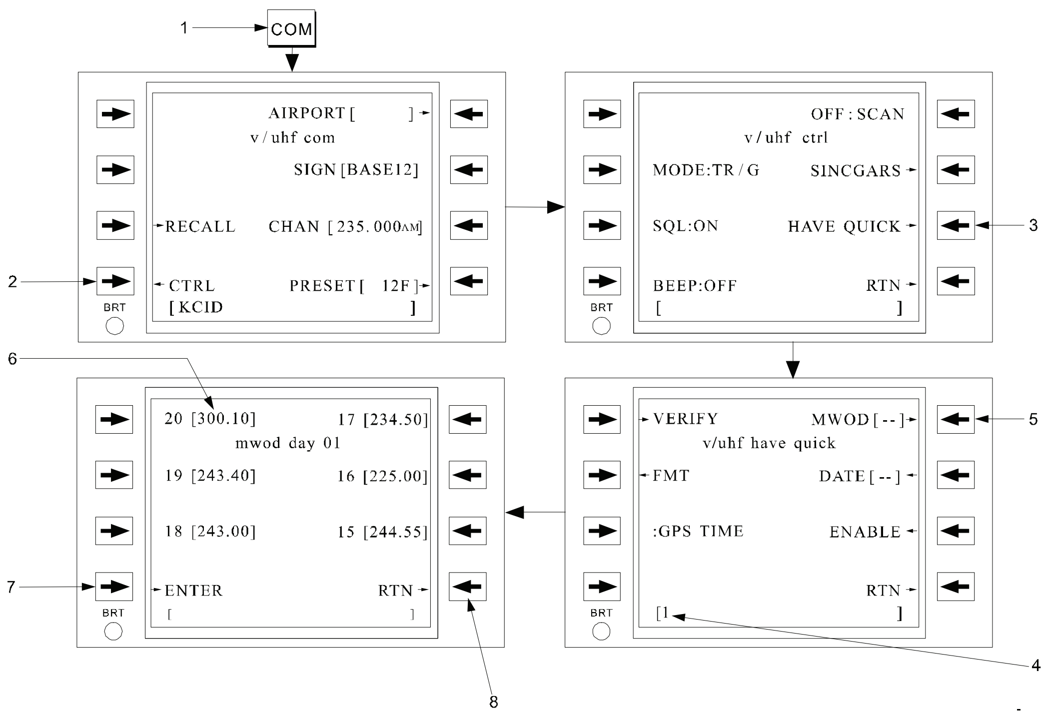


Figure 3B-124. UHF MWOD List Selection and Loading

Table 3B-87. UHF MWOD List Selection and Loading

NO.	DESCRIPTION/FUNCTION
1	Press **COM** function key to access communication page.
2	Press **CTRL** line select key to access V/UHF CTRL page.
3	Access the V/UHF HAVE QUICK setup page via the V/UHF control page.
4	Enter the MWOD date.
5	Access the V/UHF MWOD entry page for the selected day and enter the WOD elements if necessary. The MWOD elements can be loaded from the data cartridge also.
6	Element 20 must be between 200.0xx and 299.9xx or 300.1xx and 399.9xx (xx can be any two digits) for a WOD.

Table 3B-87. UHF MWOD List Selection and Loading (Continued)

NO.	DESCRIPTION/FUNCTION
7	Load the MWOD list into the corresponding V/UHF radio.
8	Return to the V/UHF HAVE QUICK setup page.

(j) Loading Frequency Management Training (FMT) Lists. An FMT list can be created manually using the V/UHF FMT Load pages or loaded from the data cartridge. Refer to Figure 3B-125 and Table 3B-88. To load each FMT element into the FMT list manually, access the FMT Load pages as shown in Figure 3B-125. Finally, to load the FMT list into the V/UHF radio, press the **ENTER** line select key on any of the V/UHF FMT Load pages. When an FMT list is successfully loaded into the V/UHF radio, the radio will acknowledge each FMT element load with a short tone, ending with two headset beeps.

NOTE

FMT elements can be manually entered or loaded from the data cartridge.

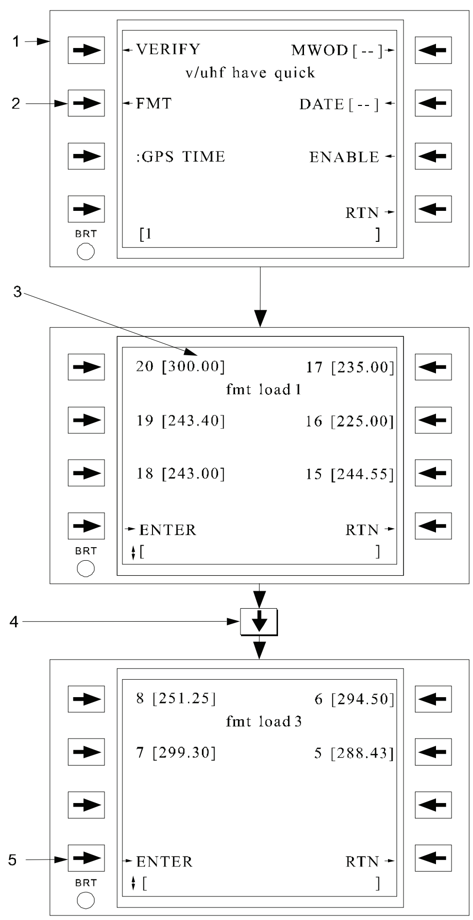


Figure 3B-125. V/UHF FMT List Selection and Loading

Table 3B-88. V/UHF FMT List Selection and Loading

NO.	DESCRIPTION/FUNCTION
1	Refer to Figure 3B-130 for details on how to access the V/UHF 1 HAVE QUICK setup page.
2	To access FMT load 1 page.
3	Element 20 must be set to 300.0xx (xx can be any two digits) for an FMT list.
4	Scroll to the V/UHF FMT load page 2 and 3.
5	Load the FMT list into the corresponding V/UHF radio.

(k) Entering Active MWOD Date. To set the V/UHF radio to the desired date and enable the MWOD list for the given date, enter the date in the scratchpad (one or two digits representing the calendar day of the month) and press the **DATE** line select key on the V/UHF HAVE QUICK II Setup page. The V/UHF radio will acknowledge the load with one headset tone Figure 3B-126 and Table 3B-89.

The **VERIFY** line select key on the V/UHF HAVE QUICK II setup page performs two functions: it verifies WOD's have been entered for a given date, and performs a reset function by taking the V/UHF radio's HAVE QUICK computer off-line momentarily. To verify WOD's are loaded for a given date, enter the date in the scratchpad and press the **VERIFY** line select key. To reset the HAVE QUICK computer, ensure the scratchpad is cleared and then press the **VERIFY** line select key.

(l) HAVE QUICK Time Synchronization. To synchronize the V/UHF HAVE QUICK radios, access the V/UHF HAVE QUICK Setup page, and select the desired synchronize mode. Select GPS TIME to synchronize the radio to GPS UTC. Select RECV TIME or SEND TIME to receive or send a time synchronization from another radio. Select RESET TIME to reset the internal clock when no other time is available. Activate the time synchronization by pressing the **ENBLE** line select key.

When performing GPS time synchronization, first confirm that the GPS time figure of merit is reasonable by monitoring the 95 percent ERR display on the GPS INAV page. Although this is the position error, it is directly proportional to time error. If the 95% ERR value is less than 0.40 nm the GPS time figure of merit should be adequate for time synchronization.

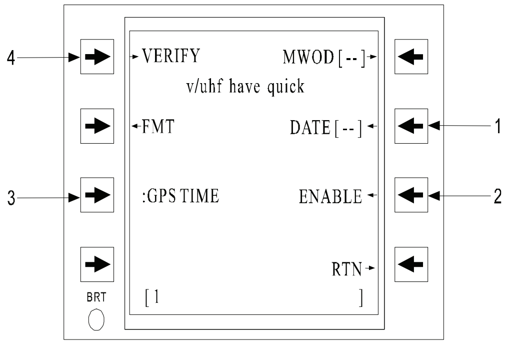


Figure 3B-126. HAVE QUICK Setup Page

Table 3B-89. HAVE QUICK Setup Page

NO.	DESCRIPTION/FUNCTION
1	Enter active date for MWOD.
2	Enable time synchronization.
3	Select type of time synchronization: GPS, RECV, SEND, or internal clock RESET.
4	Verify MWOD loaded for given date or reset radio.

(m) Tuning HAVE QUICK Net Identifiers. HAVE QUICK I/II net identifiers are entered on the Communication page identically to normal communication frequencies except that an A must be entered in the hundreds digit (i.e., A01.125 is a valid net identifier entry). Table 3B-90 lists valid HAVE QUICK I/II net identifiers for combat and training nets.

Table 3B-90. HAVE QUICK I/II Net Identifiers

NET TYPE	VALID NET IDENTIFIER	FUNCTION
Combat MWOD	Axx.x00 *	A/B Nets
	Axx.x25	NATO Nets
	Axx.x50	Non – NATO Nets
Training MWOD	A00.x0	Training Net
	A0x.x25	FMT Net
* x = any integer		

(n) V/UHF SINCGARS Functionality. The FMS-800 controls the following SINCGARS functions of the V/UHF radio:

1. Electronic Remote Fills (ERF's).

2. Late net entries.

3. Time requests.

4. Cold start, Cue and Net master selection.

The V/UHF SINCGARS Control page may be accessed via the V/UHF Control page. Refer to Figure 3B-127 and Table 3B-91.

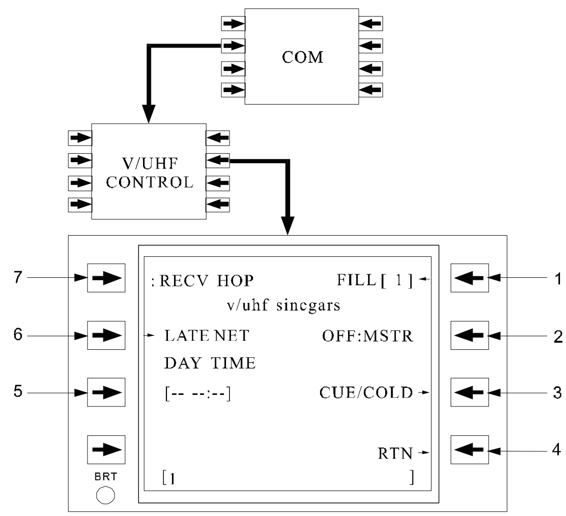


Figure 3B-127. SINCGARS Page Access

Table 3B-91. SINCGARS Page Access

NO.	DESCRIPTION/FUNCTION
1	Enter hopset/lockout number or enable fill with a blank scratchpad.
2	Enable V/UHF as net control station master.
3	Access cue/cold preset page.
4	Access V/UHF control page.
5	Enter day/time for net synchronization.
6	Enable late net entry.
7	Select ERF fill type.

(o) Electronic Remote Fill (ERF). To activate an ERF of hopset or lockout frequencies for

SINCGARS, select the type of ERF by toggling the line select key between the following:

1. RECV HOP (Receive Hopset).
2. RECV LOCK (Receive Lockout).
3. SEND HOP (Send Hopset).
4. SEND LOCK (Send Lockout).

Enter the hopset or lockout number at line select 1R, and select line select 1R once more to activate the ERF. Valid hopsets will be 1 - 25 and valid lockouts will be 1 - 8.

(p) Late Net Entry. To access a SINCGARS net that has already been established, press line select key 2L. The hopset and lockout variables must already be established to allow entry into the net. Late net entries will be enabled or disabled as long as the radio is not the net master.

(q) Time Synchronization. To update the time synchronization of the SINCGARS net as a Station Master, enter a day/time for synchronization at the appropriate line select key. The correct entry format is DDHHMM, where DD is the date (range 0 – 99), HH is the hour (range 0 – 23), and MM is the minute (range 0-59). With a blank scratchpad, the CDU will request a current time synchronization from the V/UHF radio and display the synchronized time.

(r) Net Control Station Master Selection. If the V/UHF radio has been designated as the master control station radio, select **MSTR** to enable the master synchronization of all net radios from this radio. The designated radio must be operating in an anti-jam mode when selected.

(s) V/UHF Cue/Cold Page. The V/UHF cue/cold page may be accessed from the V/UHF SINCGARS Control page or the Communications page if the V/UHF radio is tuned to the cue or cold preset Figure 3B-128 and Table 3B-92.

(t) Cold Start Operation. To initially open a SINCGARS net, enter a cold start frequency and select that frequency. The cold start frequency will be enabled on the Communication page. To activate the net, use the ERF set-up procedures as described above and synchronize the net radios.

(u) Cue Operation. To enter an active SINCGARS net, enter the cue frequency and select that frequency. The cue frequency will be enabled on the Communication page to allow entry into the SINCGARS net.

(3) Head-Up Communication Radio Data. The FDS-255 provides the pilot heads up display of the V/UHF communication radio data on the Flight Display Free Format Line (FFL) as shown in Figure 3B-129 and Table 3B-93. The current tuned callsign and frequency are displayed in green on the left side of the FFL. The previous tuned callsign and frequency are displayed in cyan on the right side of the FFL. An external push button (quicktune push button) located on the pilot and copilot control yokes, is dedicated for remote communication radio frequency control.

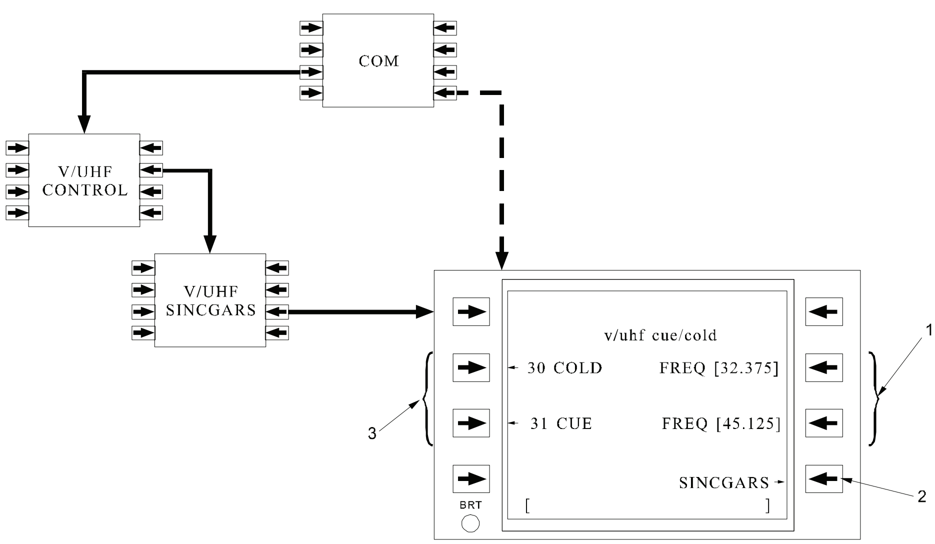


Figure 3B-128. Cue/Cold Page Access

Table 3B-92. Cue/Cold Page Access

NO.	DESCRIPTION/FUNCTION
1	Enter cold start and cue frequencies.
2	Return to SINCGARS page.
3	Select to activate cue and cold start settings of the V/UHF.

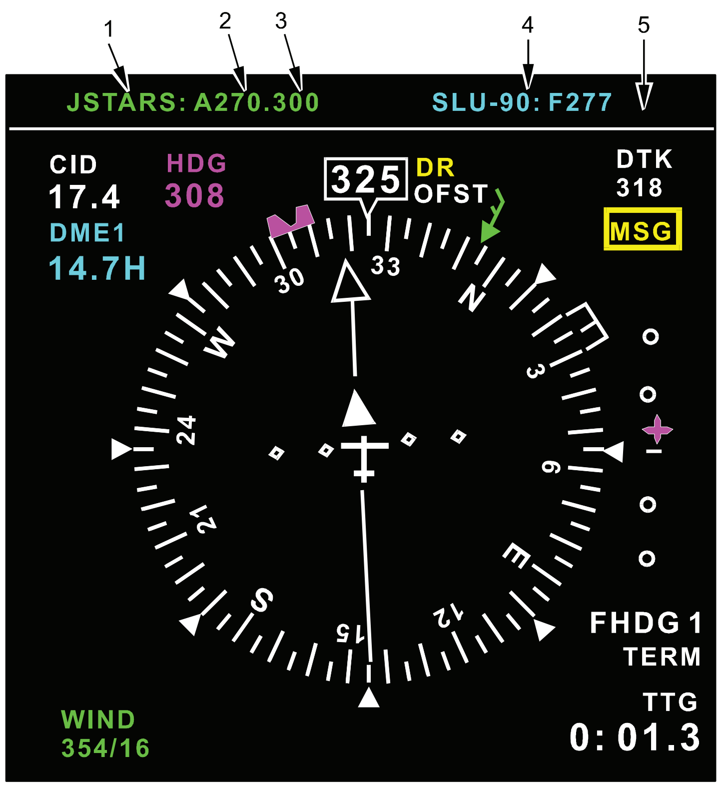


Figure 3B-129. Electronic Horizontal Situation Indicator Free Format Line

Table 3B-93. Electronic Horizontal Situation on Indicator Free Format Line

NO.	DESCRIPTION/FUNCTION
1	Callsign
2	Active frequency (green)
3	Modulation
4	Recall frequency (cyan)
5	Free format line

The quicktune push button works in conjunction with the CDU scratchpad to allow the crew to tune the radio displayed on the Electronic Horizontal Situation Indicator (EHSI). To tune the radio to the previously tuned frequency, simply press the quicktune push button without a valid entry in the CDU scratchpad. To tune the displayed radio to a different frequency, enter the frequency or callsign in the CDU scratchpad (regardless of what page is currently being displayed). Then press the quicktune push button. The V/UHF will be tuned to the new frequency and the change is reflected on both the EHSI free format line and the communication page. Refer to Figure 3B-130 and Table 3B-94 for an example of tuning a radio via the quicktune push button.

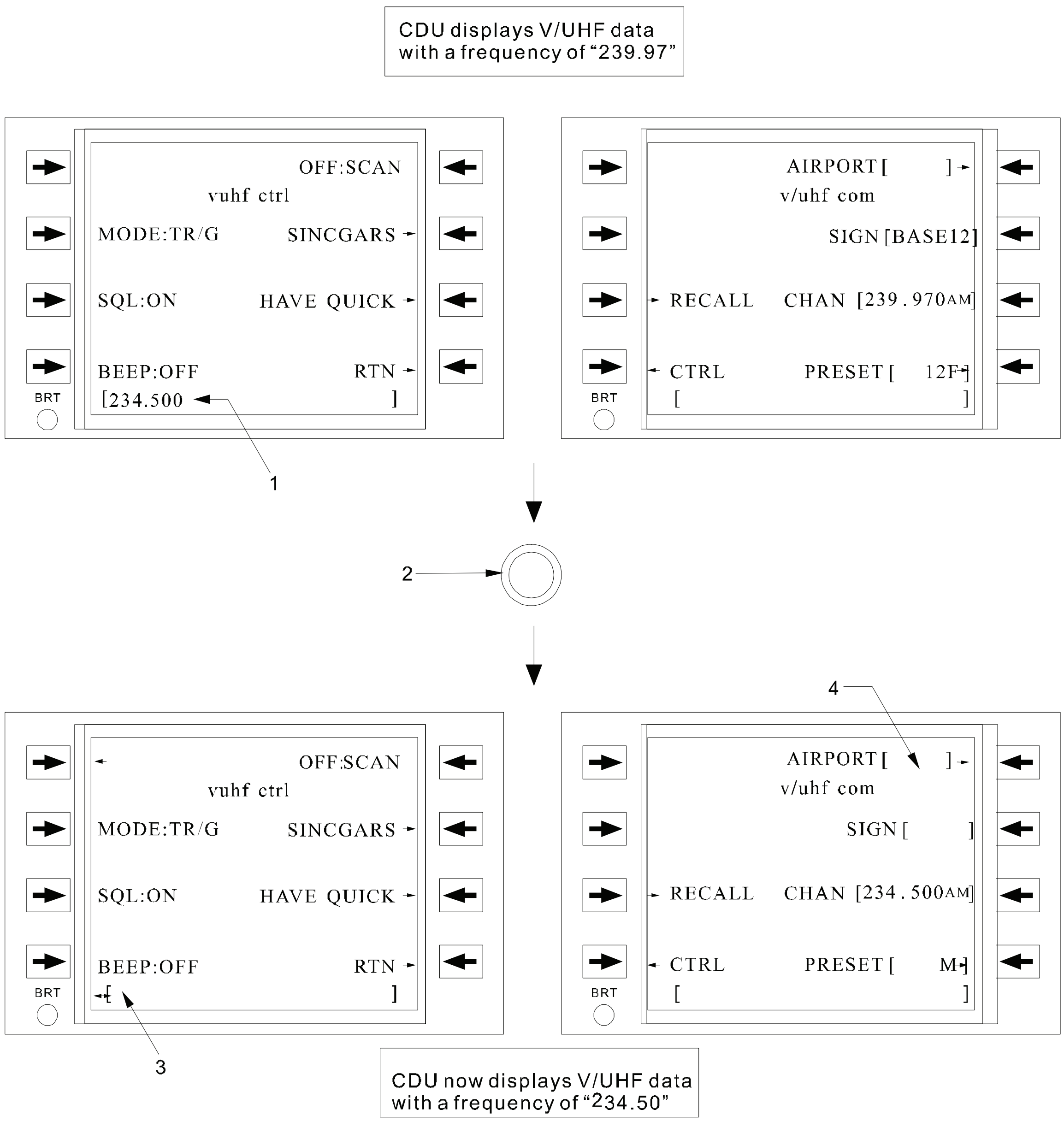


Figure 3B-130. Quicktune Push Button Example

Table 3B-94. Quicktune Push Button Example

NO.	DESCRIPTION/FUNCTION
1	Pilot enters a new V/UHF frequency in the scratchpad of the CDU.
2	Pilot presses the quicktune push button on the flight yoke.
3	The CDU scratchpad is cleared.
4	The FMS-800 updates the communication page V/UHF frequency display.

u. FMS1 Data Loader Operation.

(1) Data Loader Operation Overview. The FMS-800 data loader provides an interface to data cartridges for data storage and retrieval capability. The data loader and cartridge allows the crew to perform the following functions:

1. Load preplanned flight plans and preset information, as well as other flight data.

2. Save selected flight data, including system status information.

3. Access the ICAO identifier database.

4. Load a 200 waypoint user waypoint database.

The current magnetic variation tables can be loaded on the data cartridge and automatically transferred to the CDU nonvolatile memory upon installation of the cartridge into the data loader. If this file already exist in CDU memory, the FMS-800 will compare the new file to the existing file and determine which one is the most current. If the new file is the most current the FMS-800 will overwrite the old files.

Access to data cartridge files is performed from the data loader pages or the start 3 page. Points from the ICAO identifier database can be requested from any page where waypoint entry is permitted. Refer to Figure 3B-131 and Table 3B-95 for a description of how to access and use the Data Loader pages.

(2) Loading Flight Data. The following data can be loaded from the data cartridge, if available.

1. Any one of 40 alternate flight plans with a maximum of 60 waypoints each.

2. Markpoint and User Waypoint lists.

3. GPS almanac data.

4. Fifty-two V/UHF Communication radio presets, HAVE QUICK II MWOD, and FMT lists.

5. Navigation radio information (12 ILS/LOC frequencies).

6. Airport communication frequencies.

Most of these files can be loaded individually on the Data Loader pages.

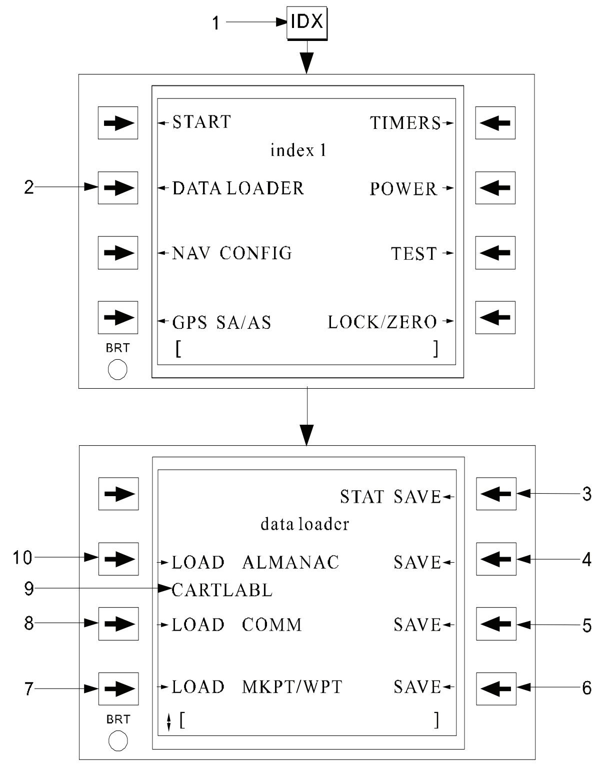


Figure 3B-131. Data Loader Page Access and Usage

Table 3B-95. Data Loader Page Access and Usage

NO.	DESCRIPTION/FUNCTION
1	Pressing function key **IDX** will access the index page.
2	Access the Data Loader pages.
3	Saves the fault history of all avionics LRU's to the cartridge.
4	Saves the current GPS almanac data to the cartridge.
5	Saves the communication radio preset data to the cartridge.
6	Saves the markpoint and waypoint lists to the cartridge.
7	Load markpoint and waypoint lists.
8	Load communication radio preset data from the cartridge.
9	The 10-character data cartridge label.
10	Load the GPS almanac data and transfer it to the GPS.

(3) Saving Flight Data. The following data can be saved individually to the data cartridge.

1. Up to 40 alternate flight plans with a maximum of 60 waypoints each.
2. Markpoint and User Waypoint lists.
3. GPS almanac data.
4. Fifty-two V/UHF Communication radio presets, HAVE QUICK II MWOD, and FMT lists.
5. System fails history of all integrated avionics LRU's that provide fault status, including continuous BIT fail history, most recent initiate BIT results, and bus status fail history.

(4) Accessing the ICAO Identifier Database. ICAO identifiers stored in the data cartridge are accessed by entering the identifier into the scratchpad and pressing a waypoint entry line select key (i.e., a line select key on a CDU page allowing entry of waypoints, for example, the Flight Plan page). Once the line select key is pressed the FMS-800 searches for the entered identifier in the data cartridge and the user waypoint list. It searches first in the data cartridge and if not found, then in the user waypoint list. If the identifier is found the corresponding information is transferred with the identifier to the CDU (i.e., waypoint type, latitude-longitude, elevation, station declination, etc.). If the identifier is not found in either database, the FMS-800 will annunciate, informing the crew that the identifier was not found in the database.

v. System Status.

(1) Status Monitoring Overview. The FMS-800 continuously monitors the status of each of the avionics system LRU's. When an LRU reports a failure with its internal Continuous Built-In Test (CBIT) routines, a √STATUS annunciation appears on the annunciation line and the CDU alert or Message (MSG) annunciation is activated.

The FMS provides continuous monitoring of CBIT results of the following LRU's:

1. CDU's.
2. Data Loader.
3. GPS Receivers.
4. ADC's.
5. V/UHF Radio.

Additionally, a detailed Status page is available for each LRU providing expanded results on both the LRU and the MIL-STD-1553B data bus for each LRU on the bus.

(2) Reporting CBIT Results. Results from CBIT routines are compiled and reported to the LRU level on the FMS Status and Navigation Status pages. A detailed status page is available for each LRU providing expanded results on the LRU itself and the MIL-STD-1553B data bus status for each LRU on the bus.

(3) System Status Page. The Status pages display the status of all the LRU's in the system and provide access to the individual LRU detail status pages. Check marks designate which LRU caused the √STATUS annunciation when a failure is detected. The LRU check mark is cleared when the detailed Status page for the failed LRU is accessed. Refer to Figure 3B-132 and Table 3B-96 for the operations of the system status page.

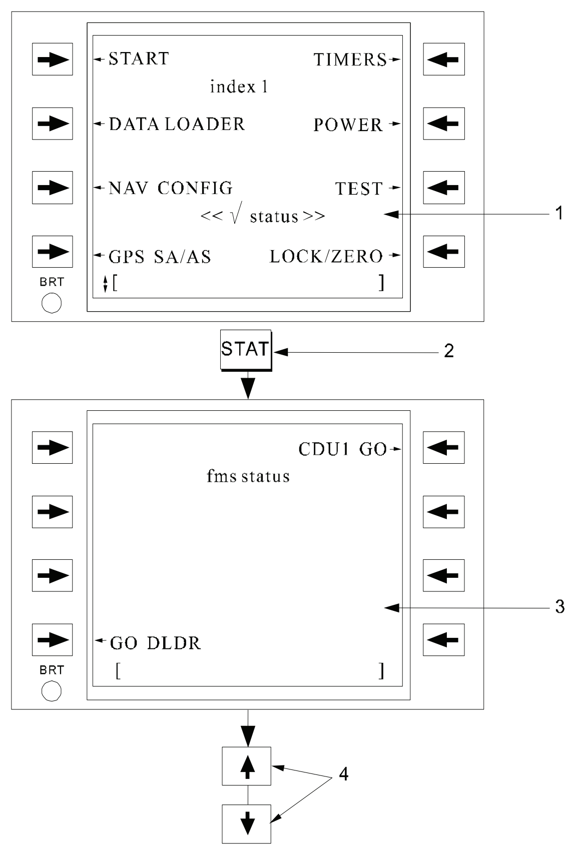


Figure 3B-132. Subsystem Status Page

Table 3B-96. Subsystem Status Page

NO.	DESCRIPTION/FUNCTION
1	The √status annunciation indicates that a failure has occurred.
2	Press to access the FMS status page.
3	The √status is cleared when FMS Status page is accessed. It can also be cleared with the **CLR** function key while on other pages.
4	Vertically scroll to access navigation sensor and navigation radio status pages.

(4) Individual LRU Detailed Status Pages. The results of CBIT's by each LRU is displayed on the respective detailed Status pages which are accessed by pressing the line select key adjacent to the respective LRU display on the Status page. Unknown status (i.e., bus controller is unable to communicate with a LRU) is indicated by dashes in the top-level status field. A failure counter is provided on all detailed Status pages to indicate the total number of hardware and MIL-STD-1553B data bus failures. Status monitoring may be disabled for any LRU on its individual Status pages (for example, if an intermittent failure is causing nuisance alerts). This prohibits the √STATUS annunciation from being displayed and the CDU alert or MSG annunciation from being activated for LRU failures. All status monitoring results continue to be displayed on the detailed Status page. The state of this selection is always reset to enable reporting on power up. Refer to Figure 3B-133 and Table 3B-97 for an example of the LRU detailed Status page. The definition of each LRU status indication is provided in Table 3B-98. Bit definition is read from left (bit 1) to right (bit 16) on each Status page. A 1 indicates a failure condition.

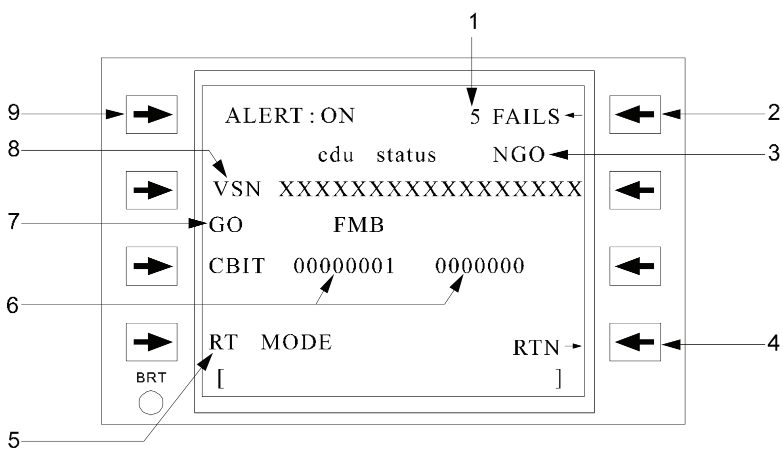


Figure 3B-133. Detailed CDU Status Page

Table 3B-97. Detailed CDU Status Page

NO.	DESCRIPTION/FUNCTION
1	Indicates the total number of failures since last reset of failure counter.
2	Resets failure counter to 0.
3	Indicates overall CDU status: GO, NGO, TST, or ---.
4	Returns to the FMS status page.
5	Indicates if CDU is either BC (bus controller) or RT (remote terminal).
6	CBIT word, detailing LRU failures, reads left-to-right and 1 indicates a failure.
7	FMB bus status: GO, NGO-A (bus A failed), NGO-B (bus B failed), NGO-T (terminal failure or both bus A and B failed).
8	OFP version.
9	Enables (ON) or disables (OFF) reporting of status monitoring annunciations.

Table 3B-98. System Failure Indications

SUBSYSTEM	FAILURE INDICATION	POSSIBLE EFFECTS
CDU Status		
Bit 1	CDU Subsystem Status	CDU may be inoperative or have impaired capability.
Bit 2	MIL-STD-1553 Terminal Status	CDU may be unable to communicate on the 1553 bus.
Bit 3 - 5	Expansion I/O Card Status	CDU may not be communicating on ARINC busses or discrete interfaces; CDU keypad entry may also be inoperative.
Bit 6	CDU Display Status	CDU display may be inoperative.
Bit 7	1553 CD Status	Not Used.
Bit 8	1553 AB Status	CDU may be unable to communicate on A and B (primary FMB) busses.
Bit 9	Serial I/O Status	CDU may not be communicating on ARINC busses.
Bit 10	Discrete I/O Status	CDU may be unresponsive to discrete inputs or incapable of generating discrete outputs.
Bit 11	Power Supply Status	CDU may be inoperative or have impaired capability.
Bit 12	Flash Memory Status	CDU program memory may be incorrect or unavailable; OFP will cease to function; Bus control relinquished.
Bit 13	NVM Status	CDU long-term memory (pilot entered data) may be incorrect or unavailable.
Bit 14	ROM Status	CDU memory may be incorrect or unavailable; Bus control relinquished.
Bit 15	RAM Status	CDU temporary memory may be incorrect or unavailable; Bus control relinquished.
Bit 16	CPU Status	CDU CPU may cease to function or have impaired capability; Bus control relinquished.
BUS	MIL-STD-1553 Bus Status	NGO-A: CDU is not responding on the A bus. NGO-B: CDU is not responding on the B bus. NGO-T: CDU is not responding on either 1553 bus.
Data Loader Status		
Bit 1-3	Not Used	
Bit 4	Terminal Address Failure	Data Loader is unable to respond on the 1553 bus.
Bit 5	Fail - Safe Timer Fail	Data Loader processor has ceased to process 1553 data; 1553 data transmission terminated.
Bit 6	Memory Checksum Failure	Data Loader program memory may be incorrect or unavailable; OFP may cease to function.
Bit 7	Not Used	
Bit 8	RAM Memory Failure	Data Loader program memory may be incorrect or unavailable.
Bit 9	Not Used	
Bit 10	LSI Fault	Data Loader 1553 circuitry failed; 1553 data transmission terminated.
Bit 11	Transmit B Bus	Data Loader has failed to transmit data on the 1553 B bus.

Table 3B-98. System Failure Indications (Continued)

SUBSYSTEM	FAILURE INDICATION	POSSIBLE EFFECTS
Bit 12	Transmit A Bus	Data Loader has failed to transmit data on the 1553 A bus.
Bit 13	Fault B Bus	1553 B data is corrupted; 1553 data transmission terminated.
Bit 14	Fault A Bus	1553 A data is corrupted; 1553 data transmission terminated.
Bit 15	Data Loader Subsystem Status	Data Loader may be inoperative or have impaired capability.
Bit 16	MIL-STD-1553 Terminal Status	Data Loader may be unable to communicate on the 1553 bus.
BUS	MIL-STD-1553B Bus Status	NGO-A: Data Loader is not responding on the A bus. NGO-B: Data Loader is not responding on the B bus. NGO-T: Data Loader is not responding on either 1553 bus.
GPS Receiver Status		
RPU	GPS Receiver CPU Status	GPS CPU may cease to function or have impaired capability.
BATT	GPS Receiver Battery Status	GPS Battery Voltage is low. Almanac data could be lost on power-down.
ADC Status		
ADC	ADC Subsystem Status	ADC may be inoperative or have impaired capability.
V/UHF Status		
Bit 1	Power Supply Ready Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 2	High Power Amp (HPA) Low Voltage Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 3	HPA Temperature Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 4	HPA Voltage Standing Wave Radio Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 5	HPA Protection Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 6	Power Amp Low Power Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 7	Synthesizer Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 8	Antenna Converter Fault	V/UHF radio receive or transmit capability may be inoperative or have impaired capability.
Bit 9	Command/Compare Fault	V/UHF radio may not respond to control commands on the 1553 bus. Radio may be operative, but control may be unavailable.
Bit 10	Not Used	
Bit 11	Applique Fault	V/UHF radio may be inoperative or have impaired capability.

Table 3B-98. System Failure Indications (Continued)

SUBSYSTEM	FAILURE INDICATION	POSSIBLE EFFECTS
Bit 12	Antenna Fault	V/UHF radio receive or transmit capability may be inoperative or have impaired capability.
Bit 13	Radio Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 14	Equipment Fault	V/UHF radio may be inoperative or have impaired capability. Verify other faults for functional degradation.
Bit 15	MIL-STD-1553 Terminal Status	V/UHF radio may be unable to communicate on the 1553 bus.
Bit 16	V/UHF Radio Subsystem Status	V/UHF radio may be inoperative or have impaired capability.
BUS	MIL-STD-1553B Bus Status	NGO-A: V/UHF radio is not responding on the A bus. NGO-B: V/UHF radio is not responding on the B bus. NGO-T: V/UHF radio is not responding on either 1553 bus.

w. Miscellaneous Functions.

(1) Miscellaneous Functions. The FMS-800 also provides the following functions that are not covered in the previous sections:

(a) Timers. Three independent stopwatch lap counters are available complete with time-out annunciations.

(b) Model Aircraft. The model aircraft inserts heading, altitude, wind, and true airspeed data into the navigation equations in order to provide a flight simulation capability.

(2) Timer Function. Access the timers by pressing the **TIMERS** line select key on the Index 1 page. The three timers can be used independently to display elapsed time (counting up to 23:59:59) or countdown to 00:00:00. They can be stopped at any time. Figure 3B-134 and Table 3B-99 shows an example of how to use the timer function.

(3) Model Aircraft Function. The model aircraft is a mission simulation capable of following all flight plan maneuvers to include holding patterns, vertical navigation, and intercepts. The model aircraft can only be operated when the weight on wheels discrete indicates the aircraft is on the ground. The ability of the model to correctly navigate is limited to the mid latitude ($< 70°$) regions and airspeed above 10 knots. Higher latitudes and low airspeeds may produce unexpected results in system response due to instabilities in the model.

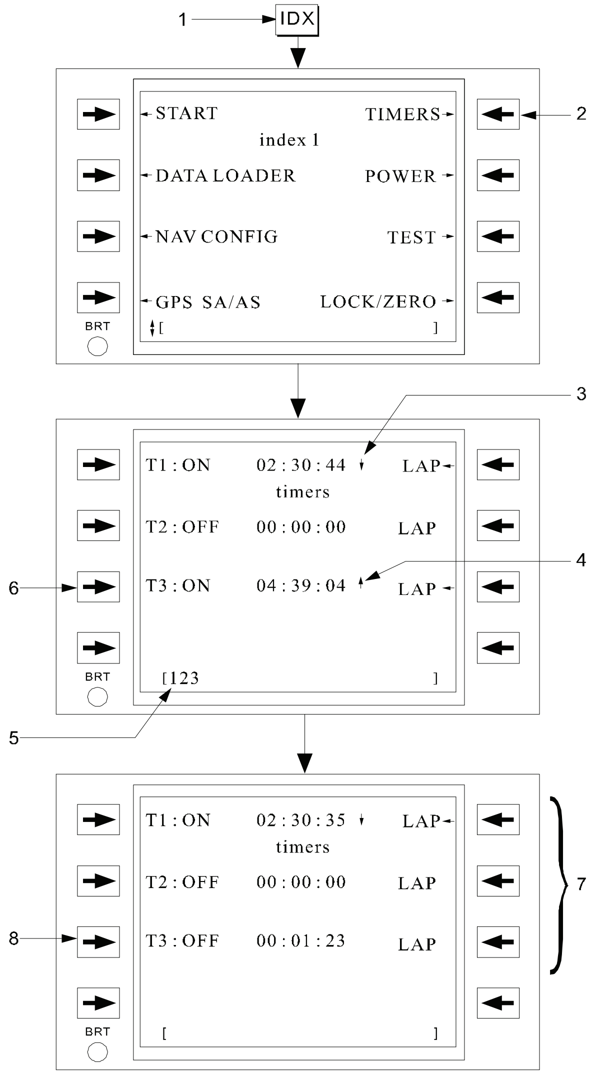


Figure 3B-134. Timer Page Access and Usage

Table 3B-99. Timer Page Access and Usage

NO.	DESCRIPTION/FUNCTION
1	Press **IDX** function key for access to index page.
2	Access timers page.
3	Timer 1 is counting down.
4	Timer 3 is counting up.
5	Enter a new countdown time in the scratchpad.
6	Set timer 3 to the new countdown time.
7	Freeze the timer display by pressing the LAP line select keys. The timer keeps running and an asterisk replaces the arrow. Unfreeze the timer display by pressing the LAP line select key.
8	Press line select key for timer 3 to automatically toggled to OFF and set to the new time. Press line select key again to start the countdown.

Prior to accessing the Model Aircraft page, enter the initial present position on the Start 1 page. Access the Model Aircraft page by pressing the **MODEL** line select key on the Index 2 page. Refer to Figure 3B-135 and Table 3B-100. Toggle the **MODE** line select key to RUNNING to run the model. All steering displays will reflect guidance information as though the aircraft were flying and executing the flight plan. Toggle the **MODE** line select key to STOPPED to stop the model.

The heading/track and speed values on the Model Aircraft page will correctly reflect the current aircraft model state and can be re-entered to different values. Two modes of heading are available: steering mode (STR) and heading hold mode (HLD). When STR mode is selected, the model's heading changes in response to steering commands calculated to follow the flight plan. When HLD mode is selected the model maintains the entered heading. Toggle the **HDG** line select key on the model aircraft page to select the desired mode.

Altitude may be entered to any desired value. When the desired vertical path has been captured the model tracks the vertical flight plan. When no altitude has been assigned a level altitude will be maintained.

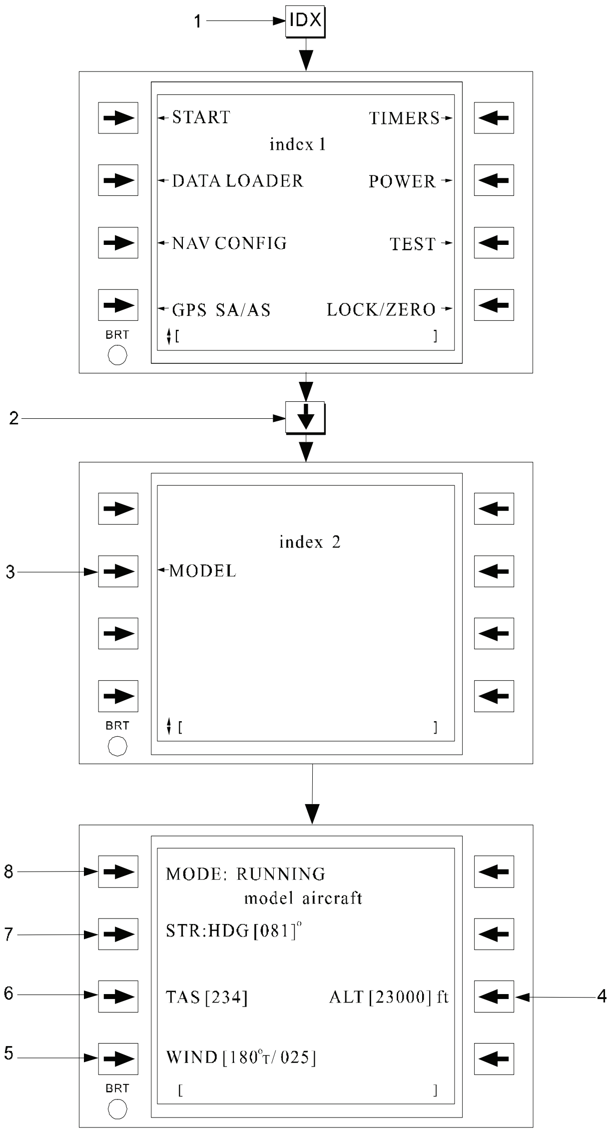


Figure 3B-135. Model Aircraft Page Access and Usage

Table 3B-100. Model Aircraft Page Access and Usage

NO.	DESCRIPTION/FUNCTION
1	Pressing **IDX** function key will access the index page.
2	Scroll to index 2 page.
3	Accesses model aircraft page.
4	Inserts the model altitude.
5	Inserts the model wind.
6	Inserts the model true airspeed.

Table 3B-100. Model Aircraft Page Access and Usage (Continued)

NO.	DESCRIPTION/FUNCTION
7	Inserts the heading; toggle heading mode between flight plan Steering (STR) and Heading Hold (HLD).
8	Toggle the line select key for either RUNNING or STOPPED modes.

x. Postflight Operations.

(1) Postflight Operations Overview. The FMS-800 postflight operations are as follows:

1. Saving and clearing GPS selective availability/anti-spoofing keys.
2. Saving GPS almanac data.
3. Saving system status data.
4. Zeroizing system data.
5. Locking the system.

(2) Saving and Clearing GPS Selective Availability/Anti-Spoofing (SA/AS) Keys. The GPS SA/AS functions are controlled on the GPS SA/AS page, which is accessed from the Index 1 page. The GPS SA/AS page indicates whether or not the GPS contains keys and the current mission duration as reported by the GPS. To change the mission duration, enter the number of days in the scratchpad and press the **DAYS** line select key on the GPS SA/AS page. Entering a duration less than the current number of loaded daily keys will zeroize any keys exceeding the desired mission duration.

To zeroize the SA/AS keys, access the Lock/Zeroize page and press the **ZERO ALL** or **GPS** line select key twice. If after a zeroize attempt the GPS SA/AS keys were not zeroized, for any reason, a NO KEYS ZERO annunciation appears. If it was zeroized, a SAFE KEYS annunciation will be displayed.

(3) Saving GPS Almanac Data. Saving the GPS almanac data to the data cartridge can ensure almanac data is available to reduce acquisition time for following flights. To save the GPS almanac data, first access the Data Loader page and then press the **ALMANAC SAVE** line select key twice.

(4) Saving System Status Data. The FMS-800 maintains an in-flight fail history of all avionic

LRU's including CBIT, IBIT, and bus status failures for later examination by maintenance personnel. To save this status data to the data cartridge, first access the Data Loader pages and then press the **STAT SAVE** line select key twice. The failed history file contains start and end dates of the record. A new fail history record will begin whenever the crew saves the status data to the cartridge.

(5) Zeroizing System Data. The Lock/Zeroize page permits selective blanking of data within CDU nonvolatile memory and the data loader cartridge. In addition to selective blanking, a single key commands a master zeroize of all data stored in the system, including, V/UHF HAVE QUICK data, and the GPS selective availability/anti-spoofing keys. Figure 3B-136 and Table 3B-101 show the Lock/Zeroize page and its associated operation in blanking different portions of system memory.

A ZERO ALL command will erase all system data. Flight plan zeroization and erasure will delete the active waypoint. Following flight plan zeroization, guidance will be indeterminate and revert to a wings-level configuration.

(6) Locking the System. The FMS-800 provides a system lock function to prevent improper investigation or tampering of system data while the aircraft is on the ground. The system lock, when activated with a password entry, disables the CDU function keys with the exception of two line select keys. One unlocks the system with the entry of the same password and one that performs a zeroization of system data.

To lock the system, access the lock/zeroize page Figure 3B-136 and Table 3B-101, enter a three-character password in the scratchpad, and press the **LOCK** line select key. Both CDU's will display the lock/zeroize page and display the LOCKED annunciation, indication the system is locked. No function keys or line select keys (other than the LOCK and ZERO ALL) are operational at this point. Once the system is locked, it can only be unlocked and the full functionality restored to the CDU's by either re-entering the same password in the scratchpad of the CDU and pressing the **LOCK** line select key or pressing the **ZERO ALL** line select key twice on the CDU to zeroize system data.

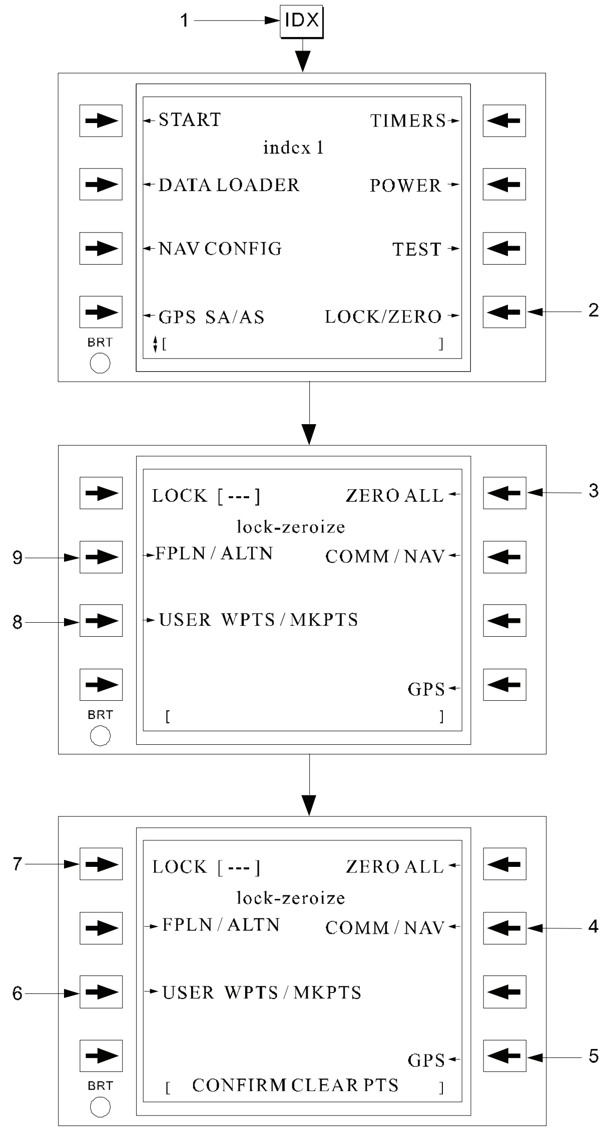


Figure 3B-136. Zeroizing or Locking Up System Data

NOTE

A zeroize command involving the CDU will erase any associated nonvolatile memory in the CDU.

All functions on this page will delete significant amounts of data stored in the CDU or other subsystem nonvolatile memory. They all require confirmation prior to execution by pressing the same key a second time to acknowledge the confirmation message.

Table 3B-101. Zoeroizing or Locking Up System Data

NO.	DESCRIPTION/FUNCTION
1	Pressing **IDX** function key will access the Index page.
2	To access the lock/zeroize page.
3	Request zeroize of all CDU data, V/UHF presets and keys, and GPS SA/AS keys.
4	Request zeroize of communication data, including presets and V/UHF HAVE QUICK data.
5	Request zeroize of GPS SA/AS keys.
6	Confirm desire to zeroize markpoint and user waypoint lists.
7	Password entry locks/unlocks the system.
8	Request zeroize of markpoint and user waypoint lists.
9	Request zeroize of flight plan and alternate flight plan.

3B-20. MFD CONTROL (EFIS).

Control of the pilot's and copilot's EADI and EHSI is through their respective control panels, located on the extended pedestal. Refer to Paragraph 3B-14.c. for a description of the control panel.

3B-21. VHF NAVIGATION RECEIVERS.

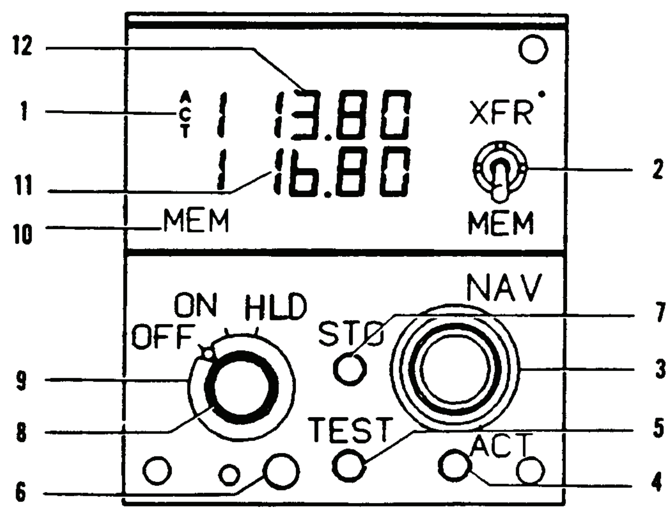
a. Description. The VIR-32 Navigation Receiver provides 200 50-kHz spaced VOR/LOC channels from 108.00 through 117.95 MHz and 40 GS channels automatically paired with localizer channels. It also provides a marker beacon receiver.

The digital VIR-32 provide VOR, LOC, and GS deviation outputs, high and low level flag signals, magnetic bearing to the station, to/from information, marker beacon lamp signals, and VOR and marker beacon audio outputs.

CAUTION

When monitoring for marker beacon passage, always listen for marker beacon audio. Do not rely solely on the marker beacon lights.

b. Operating Controls. All operation controls for the VIR-32 are located on the CTL-32 NAV Control. Refer to Figure 3B-137.



1. Compare Annunciator (ACT)
2. XFR / MEM Switch
3. Frequency Select Knobs
4. ACT Button
5. TEST Button
6. Light Sensor
7. STO Button
8. Volume Control
9. Power and Mode Switch
10. Annunciators (MEM, HLD)
11. Preset Frequency Display
12. Active Frequency Display

Figure 3B-137. CTL-32 Nav Control

*(1) Compare Annunciator (**ACT**).* **ACT** momentarily illuminates when frequencies are being changed. **ACT** flashes if the actual radio frequency is not identical to the frequency shown in the active frequency display.

*(2) **XFR / MEM** Switch.* This switch is a 3-position, spring-loaded toggle switch. When held to the **XFR** position, the preset frequency is transferred to the active display and the receiver re-tunes. The previously active frequency becomes the new preset frequency and is displayed in the lower window. When this switch is held to the **MEM** position, one of the four stacked memory frequencies is loaded into the preset display. Successive pushes cycle the four memory frequencies through the display (…2, 3, 4, 1, 2 ,3…).

(3) Frequency Select Knobs. Two concentric knobs control the preset or active frequency displays. The larger knob changes the three digits to the left of the decimal point in 1-MHz steps. The smaller knob changes the two digits to the right of the decimal point 0.05-MHz steps. Frequencies roll over at the upper and lower limits. The two frequency select switches are independent of each other such that the upper and lower limit rollover of the 0.1-MHz digit will not cause the 1.0-MHz digit to change.

*(4) **ACT** Button.* Push the **ACT** button for approximately 2 seconds to enable the frequency select knobs to directly retune the receiver. The button window will display dashes and the upper window will continue to display the active frequency. Push the **ACT** button a second time to return the control to the normal 2-display mode.

*(5) **TEST** Button.* Press the **TEST** button to initiate the radio self-test diagnostic routine. (Self-test is active only when the **TEST** button is pressed.)

(6) Light Sensor. The built-in sensor automatically controls the display brightness.

*(7) **STO** Button.* The **STO** button allows up to four preset frequencies to be selected and entered into the control's memory. After presetting the frequency to be stored, push the **STO** button. The upper window displays the channel number of available memory (CH 1 through C4); the lower window continues to display the frequency to be stored. For approximately 5 seconds, the **MEM** switch may be used to advance through the channel numbers without changing the preset display. Push the **STO** button a second time to commit the preset frequency to memory in the selected location. After approximately 5 seconds, the control will return to normal operation.

(8) Volume Control. A volume control is concentric with the power and mode switch.

(9) Power and Mode Switch. The power and mode switch contain three detented positions. The **ON** and **OFF** positions switch system power. The **HLD** position allows the NAV frequency to be changed, but holds the DME to the current active frequency.

*(10) **MEM** and **HLD** Annunciators.* The NAV control contains memory (**MEM)** and hold (**HLD)** annunciators. The **MEM** annunciator illuminates whenever a preset frequency is being displayed in the lower window. The **HLD** annunciator indicates that the DME is held to the active frequency at time of selection; the NAV frequency may be changed. The upper window now displays the NAV frequency and the lower window displays the held DME frequency.

(11) Preset Frequency Display. The preset (inactive) frequency and diagnostic messages are displayed in the lower window.

(12) Active Frequency Display. The active frequency (frequency to which the VIR-32 receiver is tuned) and diagnostic messages are displayed in the upper window.

c. Operating Procedures.

CAUTION

It is not practical to provide monitoring for all conceivable system failures and, it is possible that erroneous operation could occur without a fault indication. It is the responsibility of the pilot to detect such an occurrence by means of cross-checks with redundant or correlated information available in the cockpit.

(1) Equipment Startup. The VIR-32 receiver and the CTL-32 NAV control are turned on by rotating the power and mode switch on the NAV control to the **ON** position. After power is applied, the CTL-32 displays the same active and preset frequencies that were present when the equipment was last turned off.

(2) Frequency Selection. Frequency selection is made using either the frequency select knobs, or the **XFR / MEM** (transfer/memory recall switch).

Rotation of either frequency select knob increases or decreases the frequency in the present frequency display. The larger, outer knob changes the frequency in 1-MHz increments (number to the left of decimal point). The smaller, inner knob changes the frequency in 0.05-MHz increments.

After the desired frequency is set in the preset frequency display, it can be transferred to the active frequency display by momentarily setting the **XFR / MEM** switch to **XFR**. At the same time that the preset frequency is transferred to the active display, the previously active frequency is transferred to the preset display. The **ACT** annunciator on the control flashes while the receiver is tuning to the new frequency.

NOTE

If the ACT annunciator continues flashing, it indicates that the receiver is not tuned to the frequency displayed in the active display.

The CTL-32 has memory that permits storing up to four preset frequencies. Once stored, these frequencies can be recalled to the preset display by positioning the **XFR / MEM** switch to the **MEM** position. The storage location (CH 1 through CH 4) for the recalled frequency display while the **XFR / MEM** switch is held in the **MEM** position. All four stored frequencies can be displayed one at a time in the preset display by repeatedly positioning the **XFR / MEM** switch to the **MEM** position. After the desired stored frequency has been recalled to the preset display; it can be transferred to the active display by momentarily positioning the **XFR / MEM** switch to the **XFR** position.

During normal operation, all frequency selections and revisions are done in the preset frequency display. However, the active frequency can be selected directly as described in the direct active frequency selection paragraph.

(3) Direct Active Frequency Selection. The active frequency can be selected directly with the frequency select knobs by pushing the **ACT** button for about 2 seconds. The active frequency selection mode is indicated by dashes appearing in the preset display. Also, the **ACT** annunciator will flash as the frequency select knobs are turned to indicate that the receiver is being re-tuned.

NOTE

If the ACT annunciator continues flashing after the frequency has been selected, it indicates that the receiver is not tuned to the frequency displayed in the active display.

To return to the preset frequency selection mode, push the **ACT** button again for about 2 seconds.

As a safety feature, the CTL-32 automatically switches to the active frequency selection mode when a frequency select knob is operated while the **STO**, **TEST**, or **XFR / MEM** switches are actuated.

(4) Frequency Storage. Up to four preset frequencies can be stored in the memory in the CTL-32 for future recall. To program the memory, select the frequency in the preset frequency display using the frequency select knobs and push the **STO** button once. One of the channel numbers (CH 1 through CH 4) will appear in the active display for approximately 5 seconds. During this time, the channel number can be changed, without changing the preset frequency, by momentarily positioning the **XFR / MEM** switch to the **MEM** position. After the desired channel number has been selected, push the **STO** button again to store the frequency.

NOTE

When storing a frequency the second actuation of the STO button must be done within 5 seconds after selecting the channel number or the first actuation of the STO button. If more than 4 seconds elapse, the control will revert to the normal modes of operation and the second store command will be interpreted as the first store command.

After a frequency has been stored in memory, it will remain there until changed by using the **STO** button. Memory is retained even when the unit is turned off for an extended period of time.

(5) Self-Test. During self-test, the VIR-32 provides VOR, ILS, and marker beacon test outputs. The following paragraphs provide the procedures required and the results to be expected when performing the self-test.

(6) VOR Self-Test.

1. Select a VOR frequency on the NAV Control, a specific frequency is not required for test. A signal on frequency will not interfere with the self-test. Rotate the OBS to approximately 0°.

2. Press the **TEST** button on the CTL-32.

3. The NAV flag will come into view.

4. After approximately 2 seconds, the flag will go out of view, the EHSI lateral deviation bar will approximately center, and a TO indication will

appear. The EHSI pointers will indicate approximately a 0° magnetic bearing.

5. The VIR-32 will return to normal operation after approximately 15 seconds, even if the **TEST** button is held.

(7) ILS (Localizer and Glideslope) Self-Test.

NOTE

Anytime an ILS frequency is selected, the EHSI bearing pointer will drive to park at the 3 o'clock position.

1. Selection a localizer frequency on the CTL-32 NAV Control (a specific frequency is not required for test).

2. Press the **TEST** button on the CTL-32.

3. The NAV and GS flags will come into view.

4. After approximately 3 seconds, the flags will go out of view, the EHSI lateral deviation bar will deflect right approximately 2/3 of full-scale and the glideslope pointer will deflect down approximately 2/3 of full-scale.

5. The VIR-32 will return to normal operation after approximately 15 seconds, even if the **TEST** button is held.

(8) Marker Beacon Self-Test. The marker beacon assembly is tested automatically when the self-test is actuated and either a VOR or localizer frequency is selected. Proper operation of the marker beacon assembly is indicated by the flashing marker beacon annunciator on the EADI. A 20-Hz tone will also be present in the marker audio output.

(9) Marker Beacon Audio. Marker Beacon Audio generally associated with an ILS, must be source selected by the **MKR BCN 1** or **2** audio selector switches located on the audio control panel. Sensitivity selection for marker beacon audio is accomplished by a toggle switch placarded, **MKR BCN 1 & 2 HI-LO**, located to the right of the color radar.

(10) Diagnostic Display.

CAUTION

The diagnostic routines are intended as an extension of the self-test capability. The pilot should first observe the deviation indicators and associated flags for the proper self-test responses. If a fault condition exists, the problem may be verified in more detail by the diagnostics.

An extensive self-test diagnostic routine is also initiated in the VIR-32 by pushing the **TEST** button on the CTL-32. The CTL-32 will modulate the active and preset display intensity from minimum to maximum to annunciate that self-test is in progress. If a fault condition existed prior to actuating self-test, the CTL-32 will display the diagnostic code associated with the fault for approximately 2 seconds immediately after the **TEST** button is pressed (the code will appear in the preset display). If a fault is detected during self-test, that fault code will also be displayed on the CTL-32 along with the word DIAG, FLAG, or four dashes (– – – –) in the active display. The four dashes will be displayed along with the code '00' indicating that no faults have been found. FLAG will be displayed along with a 2-digit code when something is abnormal but a failure has not occurred (i.e., low signal level, etc.). DIAG is displayed along with a code to indicate a failure has been detected in the VIR-32. Completion of self-test is indicated when either the normal frequency displays or a fault code is displayed on the NAV control. A partial list of diagnostic and fault codes is provided below. The codes are listed in numerical order. The **TEST** button must be pushed before any fault code can be displayed. Refer to Table 3B-102.

(11) Normal Operation. When changing VOR frequencies and until signal lock-on, the RMI/HSI bearing pointers (OSA) the RMI bearing pointer (ANG) will drive tot he park or 3 o'clock position and the HSI Nav warning flag will be in view. In the ILS mode, the bearing pointer(s) will remain in the park position.

NOTE

During ILS operation, the NAV 1 and NAV 2 deviation relays are monitored by a failure warning system. Failure of one of these relays will be indicated by the appearance of the HSI NAV and/or VERT flags.

Table 3B-102. Fault Codes and Descriptions

CODE	DESCRIPTION AND COMMENT
00	No fault found.
02	RAM test failed. Unit unusable (μP problem).
03	No serial data to unit. Unit unusable (CTL problem).
04	No serial frequency word. Unit unusable (CTL problem).
05	Invalid NAV frequency. (CTL may be tuned to DME channel).
06	Microprocessor fault. Unit unusable.
10	Microprocessor fault. Unit unusable.
11	Analog to digital fault. Unit unusable.
12	Analog to digital failed accuracy test. Unit unusable.
13	+13 Vdc power supply fault. Unit unusable.
14	-13 Vdc power supply fault. Unit unusable.
15	VOR sin θ/LOC digital to analog fault. LOR/LOC unusable.
16	VOR cos θ/GS digital to analog fault. VOR/GS unusable.
17	VOR receiver synthesizer unlocked. VOR receiver inoperative.
18	VOR AFC not locked. VOR unusable (no rf signal).
19	Low 30-Hz reference signal. VOR unusable.
20	Low 30Hz variable signal. VOR unusable.
21	400-Hz power supply unusable. VOR OBI and OBS unusable.
22	OBI sin out of tolerance. VOR OBI and OBS unusable.
23	OBI cos out of tolerance. VOR OBS unusable.
24	OBS return out of tolerance. VOR OBS unusable.
25	LOC synthesizer unlocked. LOC receiver inoperative.
26	LOC signal level low. LOW unusable.
27	LOC deviation out of tolerance. LOC deviation unreliable.
28	GS synthesizer unlocked. GS receiver inoperative.
29	GS signal too low. GS receiver inoperative.
30	GS deviation out of tolerance. GS deviation unreliable.
32	Marker beacon fault. Observe marker lamps for fault.

3B-22. TACAN SYSTEM.

The TACAN system has been removed from the C-12T3.

3B-23. DISTANCE MEASURING EQUIPMENT (DME).

a. Description. DME readout is displayed on the EHSI in the upper left-hand corner. Distance readout can be read to the NAV source or to the bearing source. NAV sources are selected by the Course Source Selector (FMS or VOR) and the CRS1/2 button (#1 or #2). The bearing button selects the navigation source to be displayed on the EHSI bearing pointer. Bearing selections are: Off, FMS1, FMS2, VOR1, VOR2, and ADF.

(1) NAV Source Distance Readout. When distance is available for the selected navigation source, the distance source and the distance in nautical miles to the NAV source is displayed in the upper left corner of the MFD. If the NAV source is FMS, the active waypoint is displayed as the distance source. If the NAV source is VOR, DME is displayed as the distance source.

(2) Bearing Source Distance Readout. When distance is available for the selected bearing source, the bearing source and the distance in nautical miles to the source is displayed in the upper left corner of the MFD. If the bearing source is FMS, the active waypoint is displayed as the distance source. If the bearing source is VOR, DME is displayed as the distance source.

b. Power. Twenty-eight Vdc is provided to the DME through a 2-ampere circuit breaker, placarded DME, located on the copilot's right circuit breaker panel.

c. Control and Functions.

(1) DME Hold. DME hold can only be selected on VOR 1 NAV source by placing the mode switch to **HLD** on the CTL-32 NAV Control.

(2) Course Distance Readout. The distance readout displays tenths of a mile up to 99.9 nm and above 99.9 nm it is displayed in whole miles. If VOR is the selected course source and VOR is in DME Hold mode, a white H is annunciated to the right of the DME distance.

When the distance is invalid, the digital portion of the readout is replaced with red dashes and the distance source is replaced with the course source annunciation. If the distance is unavailable, the distance identifier is replaced with the course source annunciation and digital portion of the readout blanks.

(3) Bearing Distance Readout. The distance readout displays tenths of a mile up to 99.9 nm and above 99.9 nm it is displayed in whole miles. If VOR is the selected bearing source and VOR is in DME Hold mode, a blue H is annunciated to the right of the DME distance.

When the distance is invalid, the digital portion for the readout is replaced with red dashes. If the distance is unavailable, the digital portion of the readout blanks. When the bearing source is invalid or not available, the distance source is replaced with the bearing source annunciation drawn in black on a solid red box.

3B-24. AUTOMATIC DIRECTION FINDER (ADF).

a. Description. The ADF-60 system provides aural reception of signals from a selected ground station and indicates relative bearing to that station. The ground station must be within the frequency range of 190 to 1749.5 kHz. The ADF-60 system has three functional modes of operation. In ANT mode, the ADF receiver functions as an aural receiver, providing only an aural output of the received signal. In ADF mode, it functions as an automatic direction finder receiver in which relative bearing-to-the-station is presented on EHSI, and an aural output of the received signal is provided. A TONE mode provides a 1000-Hz aural output tone, when a signal is being received, to identify keyed CW signals.

b. Operating Controls and Functions. All operating controls for the ADF-60 system are located on the CTL-62 ADF Control. Refer to Figure 3B-138.

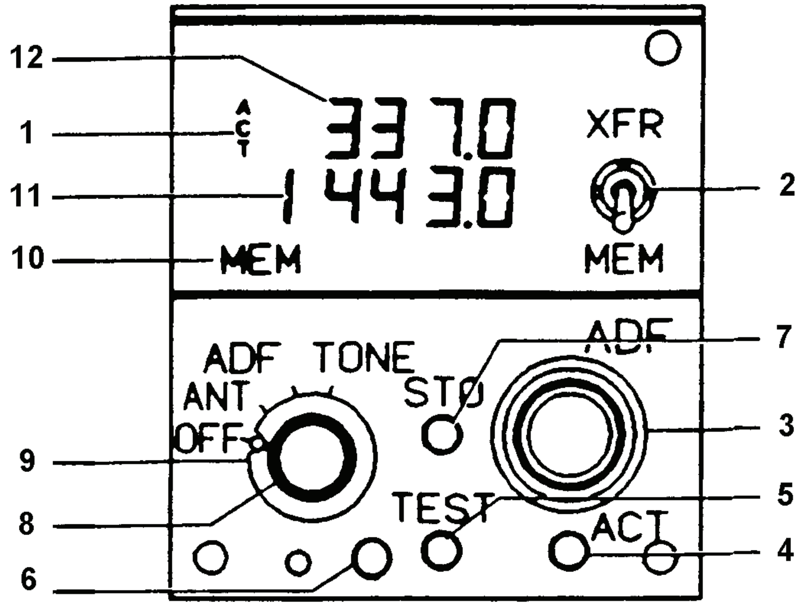
(1) Compare Annunciator. **ACT** momentarily illuminates when frequencies are being changed. **ACT** flashes if the actual radio frequency is not identical to the frequency shown in the active frequency display.

(2) ***XFR / MEM*** *Switch*. This switch is a 3-position, spring-loaded toggle switch. When held to the **XFR** position, the preset frequency is transferred up to the active display and the ADF-60 re-tunes. The previously active frequency becomes the new preset frequency and is displayed in the lower window. When this switch is held to the **MEM** position, one of the four stacked memory frequencies is loaded into the preset display. Successive pushes cycle the four memory frequencies through the display (…2, 3, 4, 1, 2, 3…).

(3) Frequency Select Knob. Two concentric knobs control the preset or active frequency displays. The larger knob changes the 1000's and 100's kHz digits. The smaller knob changes the 10's, units, and tenths kHz digits. Each detent of the larger knob changes the frequency in 100-kHz steps. Each detent of the smaller knob change the frequency in 1-kHz steps with the exception that the first two detent positions following a change in rotational direction will cause a 0.5-kHz change. Rapid rotation of the smaller knob will cause frequency changes greater than 1 kHz as a function of the rate of rotation. Frequencies roll over at the upper and lower limits. The two frequency select switches are independent of each other such that the upper and lower limit rollover of the 10-kHz digit will not cause the 100-kHz digit to change.

(4) ***ACT*** *Button*. Push the **ACT** button for approximately 2 seconds to enable the frequency select knobs to directly retune the ADF-60. The bottom window will display dashes and the upper window will continue to display the active frequency. Push the **ACT** button a second time to return the control to the normal 2-display mode.

(5) ***TEST*** *Button*. Press the **TEST** button to initiate the radio self-test routine. (Self-test is active only when the **TEST** button is pressed.)



1. **Compare Annunciator (ACT)**
2. **XFR / MEM Switch**
3. **Frequency Select Knobs**
4. **ACT Button**
5. **TEST Button**
6. **Light Sensor**
7. **STO Button**
8. **Volume Control**
9. **Power and Mode Switch**
10. **Annunciators (MEM, HLD)**
11. **Preset Frequency Display**
12. **Active Frequency Display**

Figure 3B-138. ADF Control

(6) Light Sensor. The built-in light sensor automatically controls the display brightness.

*(7) **STO** Button*. The **STO** button allows up to four preset frequencies to be selected and entered into the control's memory. After presetting the frequency to be stored, push the **STO** button. The upper window displays the channel number of available memory (CH 1 through CH 4); the lower window continues to display the frequency to be stored. For approximately 5 seconds, the **MEM** switch may be used to advance through the channel numbers without changing the preset display. Push the **STO** button a second time to commit the preset frequency to memory in the selected location. After approximately 5 seconds, the control will return to normal operation.

(8) Volume Control. A volume control is concentric with the power and mode switch.

(9) Power and Mode Switch. The power and mode switch contains four detented positions. The **OFF** position removes system power. Selecting **ANT**, **ADF**, or **TONE** applies power to the ADF system and establishes the system mode of operation.

(10) Annunciators. Displays annunciator fields.

(11) Preset Frequency Display. The preset (inactive) frequency and diagnostic messages are displayed in the lower window.

(12) Active Frequency Display. The active frequency, frequency to which the ADF-60 is tuned, and diagnostic messages are displayed in the upper window.

c. Operating Procedures.

CAUTION

It is not practical to provide monitoring for all conceivable system failures and, however unlikely, it is possible that erroneous operation could occur without a fault indication. It is the responsibility of the pilot to detect such an occurrence by means of cross-checks with redundant or correlated information available in the cockpit.

(1) Equipment Turn On. The ADF-60 receiver and the CTL-62 ADF Control are turned on by rotating the power and mode switch on the ADF control to the **ANT**, **ADF**, or **TONE** position.

After power is applied, the CTL-62 displays the same active and preset frequencies that were preset when the equipment was last turned off.

(2) Frequency Selection. Frequency selection is made using either the frequency select knobs, the **XFR / MEM** (transfer/memory recall switch).

For future developments, the CTL-62 has a normal frequency range of 190.00 to 1799.5 kHz. However, when used with the ADF-60, the upper frequency is limited to 1749.5 kHz. Rotation of either frequency select knob increases or decreases the frequency in the preset frequency display. The larger outer knob changes the frequency in 1000- and 100-kHz increments (first and second numbers from the left). The smaller inner knob changes the frequency in 10's, units, and tenths kHz increments (third, fourth, and fifth numbers from the left).

After the desired frequency is set in the preset frequency display, it can be transferred to the active frequency display by momentarily setting the **XFR / MEM** switch to **XFR**. At the same time that the preset frequency is transferred to the active display, the previously active frequency is transferred to the preset display. The **ACT** annunciator on the control flashes while the receiver is tuning tot he new frequency.

NOTE

If the ACT annunciator continues flashing, it indicates that the receiver is not tuned to the frequency displayed in the active display.

The CTL-62 has a memory that permits storing up to four preset frequencies. Once stored, these frequencies can be recalled to the preset display by positioning the **XFR / MEM** switch to the **MEM** position. The storage location (CH 1 through CH 4) for the recalled frequency is displayed in the active frequency display while the **XFR / MEM** switch is held in the **MEM** position. All four stored frequencies can be displayed one at a time in the preset display by repeatedly positioning the **XFR / MEM** switch to the **MEM** position. After the desired stored frequency has been recalled to the preset display, it can be transferred to the active display my momentarily positioning the **XFR / MEM** switch to the **XFR** position.

During normal operation, all frequency selections and revisions are done in the preset frequency display. However, the active frequency can be selected directly, as described in the following paragraph.

(3) Direct Active Frequency Selection. The active frequency can be selected directly with the frequency select knobs by pushing the **ACT** button for about 2 seconds. The active frequency selection mode is indicated by dashes appearing in the preset display. Also, the **ACT** annunciator will flash as the frequency select knobs are turned to indicate that the transceiver is being re-tuned.

NOTE

If the ACT annunciator continues flashing after the frequency has been selected, it indicates that the receiver is not tuned to the frequency displayed in the active display.

To return to the preset frequency selection mode, merely push the **ACT** button again for about 2 seconds.

As a safety feature, the CTL-62 automatically switches to the active frequency selection mode when a frequency select knob is operated while the **STO**, **TEST**, or **XFR / MEM** switches are actuated, or the memory recall inputs to the control are grounded.

(4) Frequency Storage. Up to four preset frequencies can be stored in the memory in the CTL-62 for future recall. To program the memory, select the frequency in the preset frequency display using the frequency select knob and push the **STO** button once. One of the channel numbers (CH 1 through CH 4) will appear in the active display for approximately 5 seconds. During this time the channel number can be changed without changing the preset frequency by momentarily positioning the **XFR / MEM** switch to the **MEM** position. After the desired channel number has been selected, push the **STO** button again to store the frequency.

NOTE

When storing a frequency, the second actuation of the STO button must be done within 5 seconds after selecting the channel number or the first actuation of the STO button. If more than 5 seconds elapse, the control will revert to the normal modes of operation and the second store command will be interpreted as the first store command.

After a frequency has been stored in memory, it will remain there until changed by using the **STO** button. Memory is retained even when the unit is turned off for an extended period of time.

d. Normal Operation.

(1) Function Selection. Position the power and mode switch to **ANT**, **ADF**, or **TONE**.

(2) Frequency Selection. Using the preceding frequency select procedures, tune the ADF until the desired frequency is indicated in the active frequency display and verify the station identifier.

(a) ANT Function. Position the power and mode switch to **ANT**. The RMI pointer will park horizontally. Select **ADF** on the audio system and adjust the volume.

(b) ADF Function. Position the power and mode switch to **ADF**. The RMI pointer will indicate relative bearing to the turned station.

NOTE

When the ADF system is not receiving a reliable signal, the RMI pointer will remain parked in the ADF mode. The ADF may momentarily park during station crossings because of signal loss. If the bearing pointer fails to respond as indicated or ID is lost in ANT position, the ADF should be considered unreliable and will not be used for navigation or approaches.

(c) TONE Function. Position the power and mode switch to **TONE**. A 1000-Hz tone will identify keyed CW stations.

e. Self-Test.

NOTE

If the signal received is weak or of poor quality, the bearing pointer rotation will be slow.

1. Position the power and mode switch to **ADF** and tune a nearby NDB, outer marker, or broadcast station and press the **TEST** button. The RMI pointer will rotate 90° from the previous valid indication.

2. Release the **TEST** button and verify that the RMI pointer returns to that indication. Select **ANT** on the ADF control panel. Bearing pointer should point horizontally, and a valid aural navaid identifier (ID) should continue.

3. Select **ADF** on the control panel. The bearing pointer should return to the proper relative bearing.

3B-25. GLOBAL POSITIONING SYSTEM (KLN 90B).

Refer to Chapter 3D for detailed information.

3B-26. FMS 1 DATA LOADER.

A Data Loader for the FMS 1 is located on the lower pedestal. A Data Loading Cartridge is used to load flight plans, save flight data, and provide access to ICAO identifier. Refer to Paragraph 3B-19u for a detailed description of the Data Loader Operations.

3B-27. ALTITUDE SELECT CONTROLLER.

a. Description. The Altitude Select Controller, located in the center of the instrument panel, provides a means for setting the desired altitude reference for altitude alerting and altitude pre-select system. Refer to Figure 3B-139.

b. Altitude Alert. As the aircraft reaches a point 1000 feet from the selected altitude, a signal is generated to light the warning light on the altimeter and sound a warning horn for 1 second. This light remains on until the aircraft is 300 ± 50 feet or more from the selected altitude, the light is again energized and the horn is sounded. The light remains on until the aircraft returns to within 300 ± 50 feet or deviates more than 1000 feet from the selected altitude.

c. Altitude Pre-select. The altitude is selected by turning the selector knob until the altitude display reads the desired value. No further actin is taken on the controller. To initiate altitude pre-select, the **ALTSEL** button is selected on the flight director controller. The pilot must initiate a maneuver to fly toward the pre-selected altitude. Any of the following pitch modes may be engage: Pitch Hold, Airspeed Hold, or Vertical Speed Hold. Upon initiation of altitude pre-select capture, the previously selected pitch mode is automatically reset.

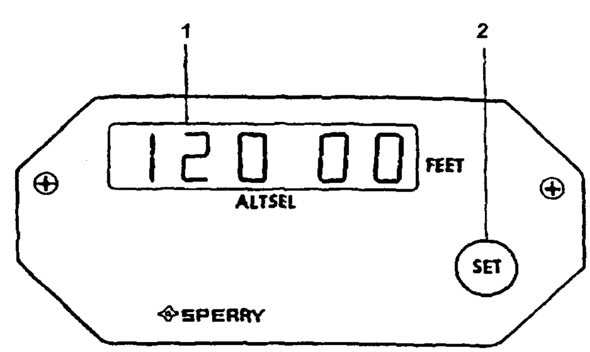


Figure 3B-139. Altitude Select Controller

3B-28. ALTIMETERS.

a. Pilot's Servoed Altimeter.

(1) Description. The pilot's altimeter provides a servoed counter drum/pointer display of barometrically corrected pressure altitude, derived from the air data computer system.

(2) Power. Power is provided through a 28-Vdc 1-ampere circuit breaker, placarded **PILOT ALTM**, located on the right hand circuit breaker panel and 26 Vac power is provided through a 1-ampere circuit breaker, placarded **PILOT ALTM**, located on the circuit breaker panel in the nose gear compartment.

(3) Operations. The servoed altimeter provides the following display.

1. Counter drum display of altitude, in 20-foot increments.
2. Pointer display of altitude between 1000-foot levels in 20-foot graduations.
3. Latitudes below 10,000 feet are annunciated by a black and white crosshatch on the left digit position of the counter display.
4. A barometric pressure counter, manually set by the **BARO** knob, displays barometric pressure in inches of mercury (Hg), and millibars (Mb), and provides this information tot he air data computer. A red warning flag in view indicates the altitude information is unreliable. However, the MODE C (altitude reporting) information may be valid.

WARNING

In the event of a total aircraft ac and dc electrical power loss, the warning flag will be in view, the altimeter will be inoperative, and the indicated altitude will remain as existed at the time of failure. A dc power loss only (retains ac power) usually results in the altimeter spooling down toward a lower altitude instead of retaining the altitude at which the power failure occurred.

The altitude (**ALT**) alert annunciator, located on the upper bezel, illuminates to provide a visual indication when the Aircraft is within 1000 feet of the pre-selected altitude during the capture maneuver and extinguishes as the aircraft is within 300 ± 50 feet of the pre-selected altitude. After capture, the light will re-illuminate if the aircraft departs more than 300 ± 50 feet from the selected altitude, and extinguish when the aircraft has departed more than 1000 feet from the selected altitude.

b. Copilot's Pneumatic Altimeter.

(1) Description. The copilot's altimeter is a pneumatic instrument equipped with a 28-Vdc internal vibrator. The vibrator is required to overcome friction and assure instrument accuracy. Altitude is displayed on the altimeter by 10,000, 1,000, and 100-foot counter drums and a single needle pointer which indicates hundreds of feet in 20-foot increments. The barometric pressure setting knob is provided to simultaneously adjust the baro counters display in inches of mercury (Hg) millibars **(**Mb). Below an altitude of 10,000 feet, a diagonal symbol will appear in the 10,000 foot counter.

(2) Power. Power is provided to the copilot's pneumatic altimeter through a 28-Vdc 1-ampere circuit breaker, placarded **COPILOT ALTM**, located in the Flight group on the right side circuit breaker panel and protects the vibrator circuit.

3B-29. RADIO ALTIMETER INDICATOR.

a. Description. The radio altimeter in the C-12T3 is integrated into the EFIS system. Digital readout of the radio altitude is displayed in white above the decision height readout area in the bottom right hand corner of the EADI. The display appears automatically when within the radio altitude range (2500 feet) and changes to 5-foot increments between 0 and 99 feet, 10-foot increments between 100 and 999, and 50-foot increments between 1000 and 2500 feet.

NOTE

Loss of Radio Altitude Data will cause loss of the TCAS II due to the absence of required power.

b. Power*.* Power to the Radio Altimeter is provided through a 28-Vdc 2-ampere circuit breaker, placarded **RADIO ALT**, located on the copilot's right hand circuit breaker panel.

c. Controls and Functions.

(1) Test Button – A **PUSH TST** button located on the EFIS control panel as the center button of the **DH SET** knob. Pushing the test button causes

the radio altimeter to go into test mode. While the radio altimeter is in test, the digital readout remains displayed, even when the radio altimeter validity is flagged.

(2) Decision Height (DH) Knob. The **DH SET** knob is used to set the decision height. Clockwise rotation increases the decision height. The decision height is displayed in green following the letters **DH** in the lower right corner of the EADI. When the radio altitude is at or below the DH setting, the yellow letters DH display in the right center portion of the EADI or PFD display and a "Minimum" aural annunciation is sounded. Once the DH annunciation displays, it is removed from the display when the radio altitude climbs at least 25 feet above the decision height. If the radio altimeter system fails, the decision height enunciator is removed and the radio altitude flag appears.

3B-30. VERTICAL GYRO SYSTEM.

The pilot's and copilot's vertical gyro systems are independent and powered by the ac power bus located in the nose avionics compartment. The purpose of the vertical gyro systems is to provide the pilots with visual indications of aircraft pitch and roll attitudes on the flight director indicators.

The gyroscope develops through synchros, pitch, and roll signals representative of the aircraft attitude. Vertical reference is established by two gravity sensitive switches that control a torque motor for each gyro axis. High or low erection rate of the gyro is accomplished by applying high or low voltage to the respective torque motor. Panel mounted switches, placarded **NO. 1** (pilot) and **NO. 2** (copilot), **V GYRO FAST ERECT**, provide the means for fast erection of the gyros. Pressing the **FAST ERECT** switch will erect the gyro to within 1.0° of pitch and roll within 60 seconds of power application, and erect within 0.5° within 2 minutes.

3B-31. GYRO MAGNETIC COMPASS SYSTEM.

a. Description. Two identical compass systems provide accurate directional information for the aircraft at all latitudes of the earth. For heading reference, two modes of operation are used: directional gyro (FREE) mode, or slaved (SLAVE) mode.

In areas where magnetic references are reliable, the system is operated in the SLAVE mode. In this mode, the directional gyro is slaved to the magnetic flux valve that supplies magnetic reference for correction of the apparent drift of the gyro. In FREE mode, the system is operated as a free gyro. In this mode latitude corrections are manually introduced using the **INCREASE / DECREASE** switches. The slave/free mode is selected as desired using the **SLAVE / FREE** switches.

Gyro compass 1 provides heading information for the pilot's HSI and copilot's RMI. Gyro compass 2 serves the copilot's HSI and the pilot's RMI.

b. Power. Both compass systems (No. 1 and No. 2) are ac power dependent, and are powered by the selected inverter.

c. Controls.

*(1) Compass 1 **SLAVE / FREE** Switch.* Located below the Turn and Slip indicator. Allows pilot to switch between SLAVE and FREE mode.

*(2) Compass 1 **INCREASE / DECREASE***. Located next to the **SLAVE / FREE** Switch. Allows manual correction to heading while in the FREE mode.

*(3) Compass 2 **SLAVE / FREE** Switch*. Located below the Turn and Slip indicator. Allow pilot to switch between SLAVE and FREE mode.

*(4) Compass 2 **INCREASE / DECREASE***. Located next to the **SLAVE / FREE** switch. Allows manual correction to heading while in the FREE mode.

Section IV. RADAR AND TRANSPONDER

3B-32. WEATHER RADAR SYSTEM.

a. Description. The Honeywell Primus 300 SL Color Radar System is a lightweight, X-band digital radar with alphanumerics designed for weather detection and analysis and ground mapping.

The primary purpose of the system is to detect storms along the flight path and give the pilot a visual indication in color of the rainfall intensity. After proper evaluation, the pilot can chart a course to avoid these storm areas.

The system performs only the function of weather detection or ground mapping. It should be used nor relied upon for proximity warning or anti-collision protection.

CAUTION

Do not operate radar system, even in standby mode, without 115-Vac, 400-Hz power, the receiver-transmitter cooling blower will not operate, which could result in circuit damage and/or automatic shutdown.

In weather detection mode, storm intensity levels are displayed in three bright colors contrasted against a deep black background. Areas of heaviest rainfall will appear in red, less severe rainfall in yellow, moderate rainfall in green, and little or no rainfall in black (background).

Range marks and identifying numerics, displayed in cyan, are provided to facilitate evaluation of storm cells. The cyclic function further emphasizes the heavy rainfall areas (red) of the weather display by flashing them approximately once per second.

Selection of the map function causes system parameters to be optimized on the three lowest ranges to improve resolution and identification of small targets at short ranges. The reflected signal from various ground surfaces is displayed as magenta, yellow, or cyan (most-to-least reflective).

The radar system consists of three units: Indicator, Receiver-Transmitter, and Antenna. The indicator is mounted in the cockpit and contains all the controls used to operate the radar. The Receiver-Transmitter is located on the radio rack. The Antenna, which is fully stabilized for aircraft pitch and roll, is the avionics compartment in the nose of the aircraft.

b. Radar System Switches and Functions. Refer to Figure 3B-140.

(1) ***INT / OFF***. Rotary control used to turn system on and off, and to adjust (intensity) of display. Turn-on, STBY, and 100 will be displayed.

(2) Display Area. Refer to Paragraph 3B-32c for details.

(3) ***10 / 25 / 50 / 100 / 200 / 300***. Momentary push buttons used to select one of six ranges. For each selected range, five range marks are displayed. At system turn-on, 100-mile range is automatically selected. Internal memory for range push buttons is always active.

(4) ***TILT.*** Rotary control used to select tilt angle of antenna beam with relation to earth (with stabilization on) or with relation to airframe (with stabilization off). Clockwise rotation tilts beam upward 0 to 10°; counterclockwise rotation tilts beam downward 0 to 10°.

(5) ***AZ MK***. Slide control used to either display or not display azimuth markers at 30° intervals.

(6) ***STAB***. Slide control used to turn antenna stabilization **ON** or **OFF**.

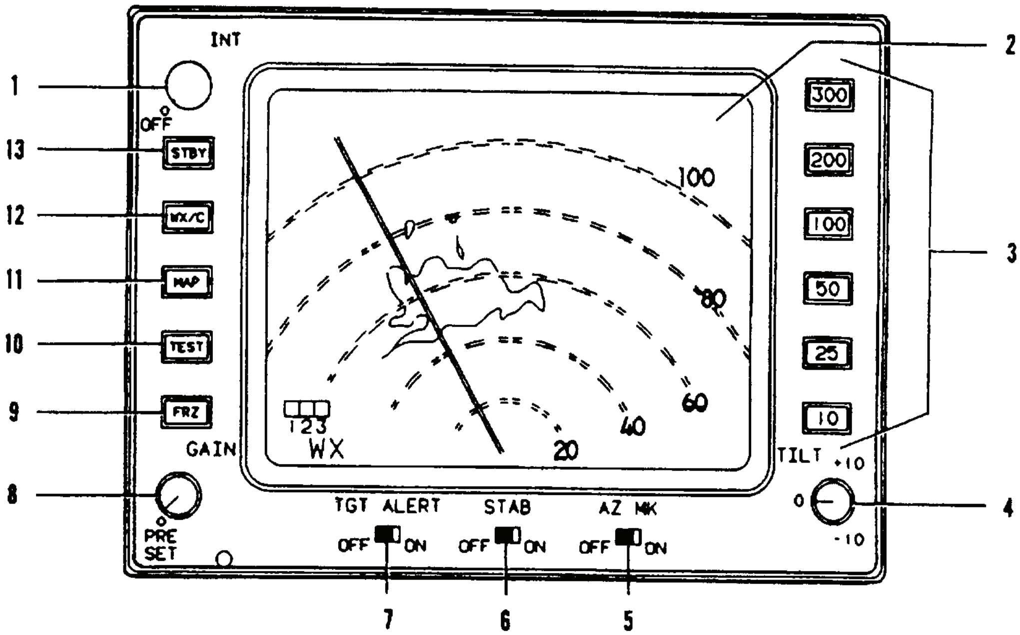
(7) ***TGT ALRT.*** Slide control used to turn target alert function **ON** or **OFF**. When enabled, the letter T in a red rectangle is displayed to identify that target alert function is active. Target alert is active only when radar gain is calibrated; i.e., in WX with GAIN PRESET and in CYC or TEST. The symbol **TGT ↑** in a red rectangle is displayed and flashes once each second whenever a red-level target is detected within the target alert section (range from 10 to 160 nm and within ±7.5° of aircraft heading). Target alert is deactivated automatically when operating controls are restored to valid alert settings.

(8) ***GAIN***. Rotary control with one fixed-gain detented position, **PRESET**. Used to adjust sensitivity of radar receiver, primarily to resolve nearby strong target signals while ground mapping. Sensitivity increases with clockwise rotation. Full counter-clockwise rotation to detent sets gain at preset level. When control is not in detented position, VAR is displayed unless preset gain has been automatically selected.

(9) ***FRZ***. Momentary push button used to turn freeze function on or off with alternate presses. When freeze is selected, display is not updated with incoming target return data. To alert pilot, FRZ label is displayed and is flashed on and off once each second. FRZ is automatically deactivated whenever selection of different control settings dictate a change in displayed data. At system turn-on, FRZ is automatically off.

(10) ***TEST***. Momentary push button used to select a special test pattern to allow verification of system operation. In test position, transmitter is not enabled; 100-mile range and preset range gain are automatically selected; and TEST is displayed.

(11) ***MAP***. Momentary push button used to select ground-mapping display; MAP is displayed.



1. **INT OFF**
2. **Display Area**
3. **10 25 50 100 200 300**
4. **TILT**
5. **AZ MK**
6. **STAB**
7. **TGT ALERT**
8. **GAIN**
9. **FRZ**
10. **TEST**
11. **MAP**
12. **WX/C**
13. **STBY**

Figure 3B-140. Color Radar Indicator

(12) ***WX/C***. Alternate action momentary push button used to select weather detection operation. If **WX/C** or **MAP** is selected prior to end of warmup period, WAIT will be displayed until RT warms up, approximately 60 seconds. After initial turn-on and warmup, the first press of **WX/C** selects weather operation and WX is displayed. The second press selects cyclic weather display; CYC is displayed. Displayed red targets flash on and off once per second; gain is automatically set to preset level.

(13) ***STBY***. Momentary push button used to select standby after radar has been used in an operating mode; e.g., WX or TEST. Standby is useful for keeping radar in ready state while taxiing, loading, etc. In standby, antenna does not scan, transmitter is not enabled, and display memory is erased. STBY is displayed in Mode Field, and 100 is displayed as the selected range numeric.

c. Display Area.

(1) Mode Field. Selected function is displayed as STBY, WX, CYC, MAP, or TEST.

WAIT is displayed until the initial RT warmup period has expired and the indicator and antenna are synchronized.

(2) Auxiliary Field. Color bar relates displayed colors to signal reflectivity levels 1, 2, 3 displayed beneath color bar.

(a) For WX, CYC, and TEST, the color bar is green, yellow, and red. For MAP, the color bar is cyan, yellow, and magenta.

(b) VAR replaces 1, 2, 3 in WX and MAP when **GAIN** control is not in detented **PRESET** position.

(c) FRZ is displayed as a blinking word when freeze function is selected.

(3) Target Field. Blank unless target alert is enabled causing letter T in red triangle to be displayed. Flashing alert symbol TGT ↑ in a red rectangle is displayed when red-level target is detected within the target alert sector.

(4) Range Mark Numerics. Five labeled range marks are displayed on each range. The fifth range mark label is larger serving to identify the selected range. Range and azimuth marks and numerics are displayed in cyan for WX, CYC, and TEST and in green for MAP.

d. Operation.

WARNING

To prevent electromagnetic radiation in ramp, terminal, taxiway, or other areas occupied by personnel, operate radar only in standby mode.

CAUTION

Do not operate radar system, even in standby mode, without 115-Vac, 400-Hz power applied to the system. Without ac power, the receiver-transmitter cooling blower will not operate, which could result in circuit damage and/or automatic shutdown.

(1) Before Turn On. Place the system controls in the following positions before applying power from the aircraft electrical system:

1. **INT / OFF – OFF** (fully counter-clockwise in detent)
2. **GAIN – PRESET** (fully counter-clockwise in detent)
3. **TILT – ±10** (fully clockwise)
4. **STAB – ON**
5. **TGT ALRT – OFF**
6. **AZ MK – OFF**

(2) Precautionary Procedures. To be performed If the radar system is to be operated in any mode other than STBY or TEST while the aircraft is on the ground:

1. Direct nose of aircraft such that antenna scan sector is free of large metallic objects such as hangars or other aircraft for a distance of 100 feet (30 meters) and tilt antenna fully upwards.
2. Avoid operation during refueling of aircraft or other refueling operations within 100 feet (30 meters).
3. Avoid operation if personnel are standing too close in the 270° forward sector of the aircraft.

(3) Self-Test Displays. A distinctive test pattern is displayed when the TEST function is selected. The following procedures may be performed to verify the operational status of the entire radar system.

1. Verify that the preliminary control settings have been made and rotate **INT / OFF** control to mid-point to turn system on. Verify that STBY is displayed in Mode field and that 100 is displayed as selected range.
2. Press **WX/C** push button and verify that WAIT is displayed in Mode field.

NOTE

A time delay circuit prevents the transmitter from operating and maintains the display blanked until the magnetron has warmed up. When the radar is turned on by pressing the WX/C or MAP push buttons, it will display WAIT and will be in standby for the 1 minute warmup period, then automatically become operational in the selected mode.

If none of the push-button switches is pressed, the radar will display STBY and be in the standby mode.

3. Press the **TEST** push button and, when the test pattern appears, verify operation of the intensity control and adjust to desired viewing level.
4. Observe the display; verify that TEST is displayed in the Mode field and that the test pattern exhibits the following characteristics:

   a. Range marks and alphanumerics are displayed in cyan

   b. Color bar and 1 2 3 are displayed in auxiliary field

   c. The colors of the first three target bands are green, yellow, and red

d. The color of the fourth target band (65 to 75 nm) is red

e. The two red target bands flash on and off approximately once each second.

5. Momentarily press **WX/C** push button and slide **TGT ALRT** control to **ON**. Verify that the letter T in a red box appears in the target alert field.

6. Press **TEST** push button and observe that when the test pattern display crosses the centerline, the T is replaced by a flashing TGT label. Slide **TGT ALRT** control to **OFF** to disable the function.

7. Verify that 100 (nm) is displayed in the upper right-hand corner and that the first four range marks are labeled with the correct numerics.

8. Slide **AZ MK** control to **ON** and verify that azimuth marks displayed in cyan at 30° intervals. Slide **AZ MK** control to **OFF** to remove azimuth marks.

9. Momentarily press **WX/C** push button to erase display, then press **TEST** push button. After approximately 2 seconds, momentarily press **FRZ** and verify that the 1 2 3 display beneath the color bar is replaced by flashing FRZ label. Verify that only a portion of the test pattern is displayed and there is no further updating. Momentarily press **FRZ** push button and verify that the display begins updating starting at the current scan position.

10. Press 10 (nm) range push button and verify that the test pattern is momentarily blanked and the restored to the previous display.

11. Momentarily press **WX/C** push button and verity that WX appears in the Mode field and 10 appears as the selected range. Verify correct range numerics.

12. Press each range push button in succession (**25 / 50 / 100 / 200 / 300**) and verify that range numerics change appropriately with each selection.

13. Momentarily press **WX/C** push button and verify that CYC is displayed in the Mode field.

14. Rotate **GAIN** control just out of **PRESET** and verify that 1 2 3 remains in the auxiliary field.

15. Momentarily press **WX/C** push button and verify that WX is displayed in the mode field and that VAR replaces 1 2 3 in auxiliary field.

16. Momentarily press **MAP** push button and verify that MAP is displayed in the Mode field. Verify that the color of the range marks and alphanumerics is green.

17. Momentarily press **STBY** push button to return radar to non-transmitting state. Return **GAIN** control to **PRESET**.

(4) Fault Displays. Display colors are continuously monitored by the color bar and 1 2 3 legend in the auxiliary field. If a fault causes a change to unfamiliar colors, the severity level denoted by the faulty color(s) is directly coded by the 1 2 3 legend.

Other circuits continuously monitor performance and loading of system power supplies. A fault resulting in power supply operation outside of preset limits will cause the system to shut down and the display will be blank. Should this occur, use the following procedure to recycle the system:

1. Rotate **INT / OFF** control to **OFF**.

2. Verify that aircraft radar circuit breaker is on.

3. After a few seconds, rotate **INT / OFF** control to mid-point and press **TEST** push button.

If the fault was of transient nature, the system may operate satisfactorily.

(5) Ground Mapping. Ground mapping operation is selected by pressing the **MAP** push button. Turn the **TILT** control down until the desired amount of terrain is displayed. The degree of downtilt will depend upon the type of terrain, aircraft altitude, and selected range.

For the low ranges (10, 25, and 50 nm), the transmitter pulse width is narrowed and the receiver bandwidth is widened to enhance the identification of small targets.

(6) Radar Stabilization. The radar stabilization system is designed to maintain the antenna beam at the selected tilt angle relative to the earth's surface. The stabilization system uses the aircraft vertical gyros as a reference and is comprised of electronic amplifiers in the Receiver/Transmitter interconnected with electromechanical components in the antenna.

(7) Level Flight. Trim aircraft for straight and level flight in smooth, clear air, over level terrain. Select a 50-mile range and set **STAB** to off.

Rotate tilt control upward until all ground returns disappear and then rotate tilt downward until ground returns just begin to appear. After several antenna sweeps, check to see that ground returns are equally displayed. If returns are only on one side of the radar screen or uneven across the radar antenna mounting and should be corrected before proceeding. Repeat this procedure until a balanced display is achieved.

Once the radar display is correct with stabilization off, select stabilization **ON** and tilt upward once again to remove all returns. Rotate tilt downward and check for even displays of ground returns. If this test indicates improper display, possible errors in the radar stabilization circuits or aircraft gyro exist.

NOTE

It is typical of a precessing aircraft gyro to cause ground returns to first appear on one side of the display, then have them shift to the opposite side of the display. This precession may not be readily apparent with respect to flight control instruments.

(8) Turns. Once proper operation is established in level flight, rotate the **TILT** control upward in 1° increments until ground returns just disappear, then rotate an additional 2° upward.

Place the aircraft in a standard rate turn to the right. Note the radar display. It should be free of returns throughout the turn indicating proper stabilization alignment.

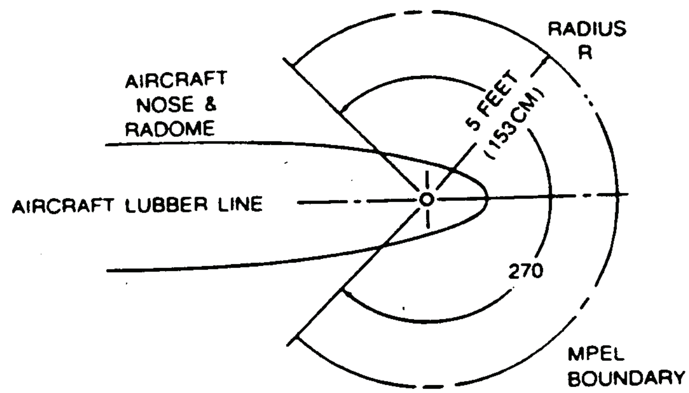
If returns display on the right side of radar indicator, the radar system is understabilizing. Targets on the left side of radar display indicate the system is overstabilizing.

In prolonged turns, gyro precession may occur which will be tracked by the stabilization system and appear as undesirable ground targets on the indicator.

e. Maximum Permissible Exposure Level (MPEL). Heating and radiation effects of weather radar can be hazardous. Personnel should remain at a distance greater than R from the radiating antenna in order to be outside of the envelope in which radiation exposure levels equal or exceed 10 mW/cm_2. Refer to Figure 3B-141. The distance (radius R) of the MPEL boundary is calculated for the radar system on the basis of radiator diameter, rated peak-power output, and duty cycle.

3B-33. TRANSPONDER (APX-100).

For information on the APX-100 Transponder, refer to Chapter 3, Paragraph 3-5.



WARNING NEVER RELY UPON WEATHER RADAR FOR PROXIMITY WARNING OR FOR ANTICOLLISION PROTECTION OR WARNING

Figure 3B-141. Maximum Permissible Exposure Level

3B-34. TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS II).

a. System Overview.

(1) The Traffic Alert and Collision Avoidance System (TCAS) is an airborne system that interrogates mode A/C and mode S transponders in nearby aircraft and uses the replies to identify and display potential and predicted collision threats to the flight crew. The system protects a volume of air space around your own aircraft. Aural and visual advisories are provided to the flight crew to assure adequate separation when a system analysis of the intruding aircraft closure rate, derived from transponder replies, predicts a penetration of the protected airspace. The TCAS II is controlled through the TTC-920 Transponder/TCAS control panel located on the pedestal.

(2) Traffic alerts and resolution advisories are indicated on the TVI-920 Transponder/TCAS Display. Traffic alerts provide the flight crew with the relative bearing and distance to intruding aircraft that are approximately 40 seconds from Closest Point of Approach (CPA). This alert provides aid in visually acquiring the intruding aircraft. No maneuvers are commanded. The resolution advisory provides threat resolution information in the form of a vertical maneuver (corrective) or restricted vertical speed range (preventive) that will increase aircraft separation when the threat aircraft is approximately 25 seconds from CPA.

(3) A traffic display and a resolution advisory display are provided to the flight crew. The traffic display consists of the relative position of mode A/C and mode S transponder equipped aircraft around the TCAS equipped aircraft. The resolution advisory display indicates the appropriate vertical maneuver or restricted vertical speed range to avoid a threat.

(4) Only operating mode A/C or mode S transponders that provide altitude information will generate resolution advisories. Only traffic alerts will be generated by mode A/C or mode S transponders that provide no altitude information, or by aircraft without transponders.

b. TCAS II Controls and Functions.

(1) Controls and functions of the TTC-920 are illustrated in Figure 3B-142 and detailed in Table 3B-103.

(2) Controls and functions of the TVI-920 Display are illustrated in Figure 3B-143 and detailed in Table 3B-104.

c. TVI-920 Transponder/TCAS Display Symbols. Symbols displayed on TCAS Display are shown in Table 3B-105.

d. TCAS Mode/Warning Flags and Messages. TCAS mode/warning flags and messages are shown in Figure 3B-144 and Table 3B-106. They may appear in one of the seven indicated slots on the display face.

e. Aural Annunciator Messages. There are two types of Aural Annunciator Messages: a Traffic Advisory Annunciation and a Resolution Advisory Annunciation. The annunciator messages are described in Table 3B-107.

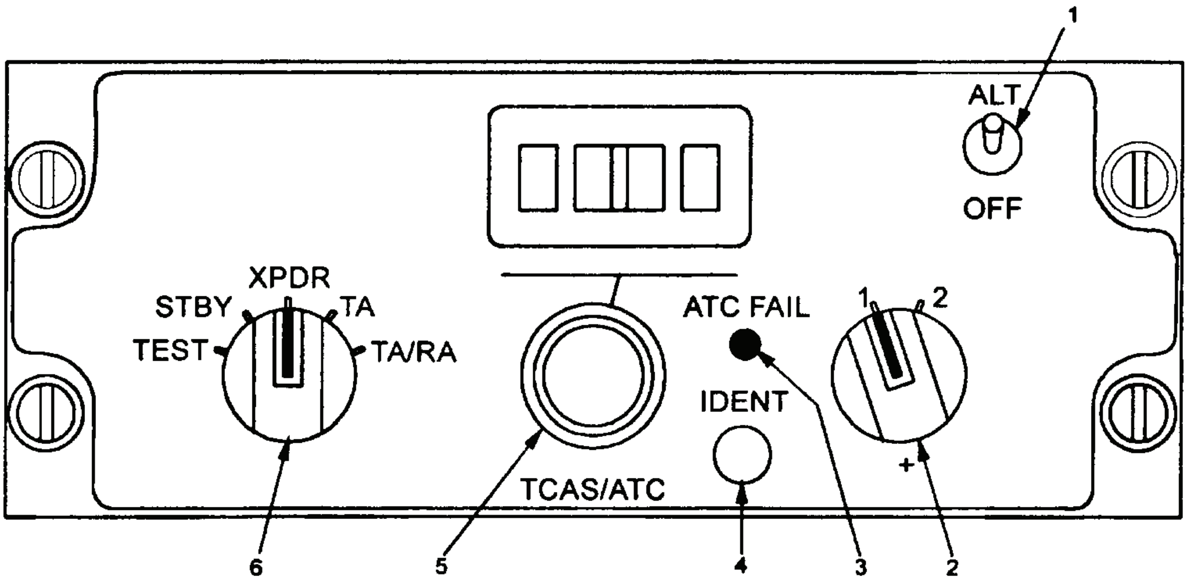


Figure 3B-142. TTC-920 Transponder/TCAS Control

Table 3B-103. TTC-920 Transponder/TCAS Control Switch Descriptions

SWITCH		LEGENDS	FUNCTION
1	Altitude Enable Switch	**ALT / OFF**	Enable altitude reporting on transponder.
2	Transponder Enable Switch	**1 / 2**	#1 enables the civilian Mode-S and #2 enables the military APX 100 transponder.
3	Fail Indicator	**ATC FAIL**	Indicates failure in transponder, control panel, antennas, or air data system when lamp remains lit.
4	Identification Button	**IDENT**	Enables transponder **IDENT**.
5	**TCAS / ATC** Mode Select Switch	0000 through 7777, as selected	Selects transponder code displayed in window.
6	Function Select Switch	**TEST / STBY / XPDR-TA / TA/RA**	Selects indicated functions (**TEST** and **STBY** apply to both TCAS and transponder. **XPDR** turns on transponder and leaves TCAS in standby. **TA** equals TA only. Other positions enable TCAS and transponder.

“M” is labeled “A/B” in this installation

Figure 3B-143. TVI-920 Transponder/TCAS Display

Table 3B-104. TVI-920 Transponder/TCAS Display

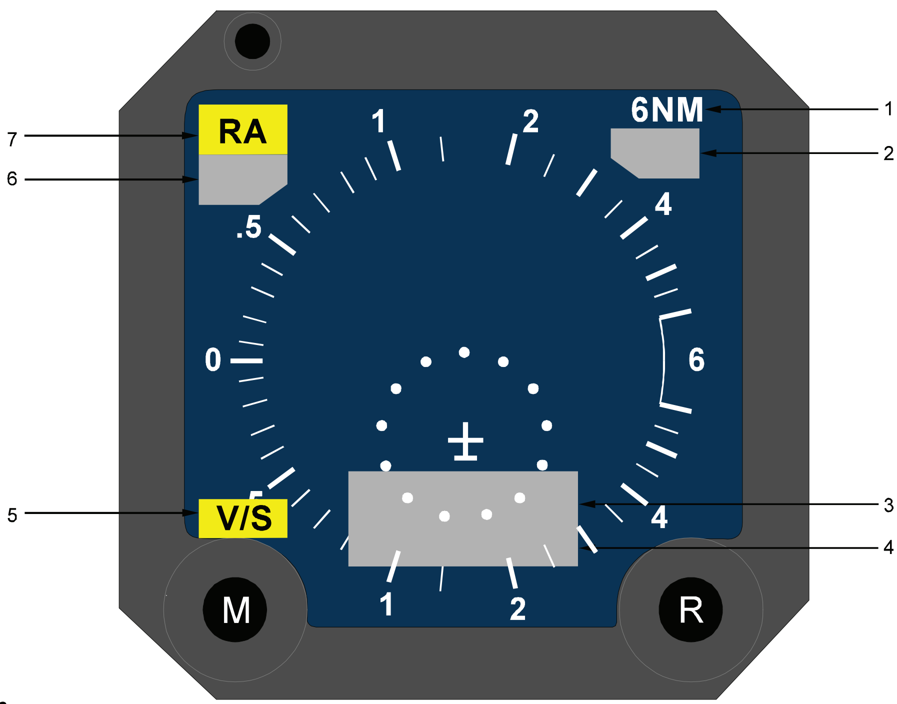
SWITCH		LEGENDS	FUNCTION
1	Above, Below, (norm) push-button selector switch	**A/B** In this installation	Selects **ABV** (above) **BLW** (below), or neither (Normal).
2	Range push-button switch	**R**	Allow selection of forward direction display range.

Table 3B-105. TV-920 Transponder/TCAS Displays

SYMBOL	INTERPRETATION
VERTICAL SPEED DISPLAY	
Vertical Speed Scale (White)	100-ft index marks from 0 to ± 1000 fpm and 500-foot index marks from ±1000 to ± 6000 fpm are always displayed.
Pointer (White)	Indicates present vertical speed. Pointer displayed when vertical speed is valid.
VERT SPEED X 1000 FPM (Cyan)	Legend displayed on indicator when TCAS is OFF and in some failure modes.
Red Arc(s)	Do not enter range if vertical speed is outside of arc (preventive resolution); exit range if vertical speed is within arc (corrective resolution).
Green Arc	Recommended “fly-to” vertical speed to resolve corrective resolution advisory.

Table 3B-105. TV-920 Transponder/TCAS Displays (Continued)

SYMBOL	INTERPRETATION
TRAFFIC DISPLAY	
Aircraft (White)	"Own aircraft" symbol. Displayed continuously when the TCAS is on and operational.
Range Ring (White)	Two-mile radius range about aircraft in all selected ranges except 40 nm. If NO BEARING message is displayed only the forward half of ring will be displayed.
Solid Square (Red)	Threat-level intruder; RA generated; range and bearing relative to own aircraft.
Solid Circle (Yellow)	TRAFFIC ALERT, potential threat-level intruder; TA generated; range and bearing relative to own aircraft.
Solid Diamond (Cyan)	Proximate traffic within ±1200 ft and 6 nm of own aircraft.
Open Diamond (Cyan)	Other traffic; beyond 6 nm and/or greater than ±1200 ft from own aircraft.
Traffic altitude tag (Same color as associated symbol)	Relative altitude of intruder. If altitude is not available, data tag is not displayed.
Vert speed trend arrow (Same color as associated symbol)	Arrow indicating direction of vertical speed change (>500 fpm) of intruder.
Partial traffic symbol (Same color as fully displayed symbol)	RA or TA intruder is off scale of the selected range; symbol at periphery of display at bearing to intruder.



"M"is labeled "A/B" this installation

Figure 3B-144. TVI-920 Transponder/TCAS Mode/Warning Flags and Messages

Table 3B-106. TVI-920 Transponder/TCAS Mode/Warning Flags and Messages

SLOT NUMBER	SYMBOL	INTERPRETATION
1	3, 5, 10, 20, or 40 NM	Selected forward range of traffic display.
1 & 2	TCAS OFF	TCAS set to standby, either manually or automatically.
3	TEST	TCAS set to test mode.
3 & 4	No bearing message (Red if RA; yellow if TA)	Range and altitude of RA or TA intruders for which no bearing information is available.
2	ABV	Traffic displayed in altitudes from +9900 ft to –2700 ft, relative to own aircraft. (If no message is displayed, traffic display is from +2700 ft to –2700 ft relative to own aircraft.)
2	BLW	Traffic displayed in altitudes from –9900 ft to +2700 ft, relative to own aircraft. (If no message is displayed, traffic display is from +2700 ft to –2700 ft relative to own aircraft.)
5	V/S	Vertical speed is unreliable, or system is in test mode.
6 & 7	ONLY T/A	When below 1100' AGL during climb or below 900' AGL during descent; or TCAS set to TA-only mode. If TA occurs, message and box border change to yellow.
7	R/A	Resolution advisory or vertical speed is unreliable.
7	TCAS	TCAS functions have failed.

Table 3B-107. Aural Annunciator Messages

MESSAGE	INTERPRETATION
Traffic Advisory Annunciation	
Traffic; Traffic	Traffic has entered 20 to 48 second to CPA envelope. (Symbol has changed to solid yellow circle.)
Resolution Advisory Annunciations (Maneuver should begin within 5 seconds)	
Climb; Climb; Climb	Climb at rate shown on vertical speed indicator.
Climb-Crossing Climb; Climb-Crossing Climb	Climb at rate shown on vertical speed indicator. Flight path will cross intruder's flight path.
Reduce Climb; Reduce Climb	Reduce rate of climb to that on vertical speed indicator.
Descend; Descend; Descend	Descend at rate shown on vertical speed indicator.
Descend, Crossing Descend; Descend, Crossing Descend	Descend at rate shown on vertical speed indicator. Flight path will cross through intruder's flight path.
Reduce Descent; Reduce Descent	Reduce rate of descent to that shown on vertical speed indicator.
Monitor Vertical Speed; Monitor Vertical Speed	Monitor present vertical speed to prevent entering restricted (red arc) vertical speed.
Increased Action Resolution Advisory Annunciations (Maneuver should begin within 2 1/2 seconds)	
Increase Climb; Increase Climb	Follows "Climb" advisory due to intruding aircraft's maneuvering or inadequate response to "climb" advisory. Rate of climb of own aircraft must be increased.

Table 3B-107. Aural Annunciator Messages (Continued)

MESSAGE	INTERPRETATION
Increase Descent; Increase Descent	Follows "descend" advisory due to intruding aircraft's maneuvering or inadequate response to “descend” advisory.. Rate of descent of own aircraft must be increased.
Climb-Climb Now; Climb, Climb Now	Follows "descend" advisory when reversal of vertical speed is required due to maneuvering of intruding aircraft.
Descend, Descend Now; Descent, Descend Now	Follows "Climb" advisory when reversal of vertical speed is required due to maneuvering of the intruding aircraft.
Threat Situation Resolved	
Clear of Conflict	Intruding aircraft is no longer a threat.

f. Traffic Display. Four types of symbols differentiated by shape and color are used to display intruders around your own aircraft. The different symbols represent Other traffic, Proximate traffic, Traffic Advisories (TA), and Resolution Advisories (RA).

(1) Off-Scale and No-Bearing Traffic. When an intruder is outside the indicator display range, the symbol associated with it will be a partial one shown at the outside edge of the display at the relative bearing to the target. As the aircraft moves into the display range, the symbol will become a full symbol as it moves into the display area. When the TCAS cannot compute bearing information on an RA or TA intruder, a text message will be displayed. For example, RA 1.4-10↑ IS A RESOLUTION ADVISORY DUE TO AN AIRCRAFT 1.4 MILES DISTANT, 1000 FEET BELOW YOUR AIRCRAFT, AND CLIMBING. The text for a RA will be red and a TA will be yellow.

(2) Other Traffic. A cyan or white open diamond indicates an Other Traffic intruder. It represents an aircraft greater than 6 nm away, and/or greater than ± 1200 feet altitude relative to your aircraft. Other traffic is not displayed on indicators operating in the pop-up mode unless a TA or RA is simultaneously present.

(3) Proximate Traffic. A Proximate Traffic intruder is displayed as a cyan or white solid diamond. It represents an aircraft within 6 nm and ±1200 feet relative altitude. These aircraft are not considered a threat, but are displayed to assist the flight crew in visually acquiring the intruders. In the pop-up mode these intruders will not be displayed unless a TA or RA is simultaneously present.

(4) Traffic Advisory Traffic. TA aircraft are displayed as a yellow solid circle. At the time an intruder is upgraded to a TA, the aural alert, "Traffic, Traffic" is annunciated. A TA is an aircraft that is within the limits from Closest Point of Approach (CPA) shown in Table 3B-108. This gives the crew time to visually acquire the intruding aircraft. No maneuvers will be commanded by the TCAS during this time. Traffic advisory traffic may be upgraded to resolution advisory traffic depending upon the intruders flight path.

Table 3B-108. Traffic Advisory Chart

ALTITUDE (FEET)	SECONDS TO CPA
Up to 1000 AGL	20
1000 – 2350 AGL	25
2350 AGL – 5000 BARO	30
5000 – 10,000 BARO	40
10,000 – 20,000 BARO	45
20,000 – Above BARO	48

The upgraded traffic advisory is displayed as a solid red square. At this time the intruder is upgraded to an RA and an aural alert advising flight action is initiated. The aural alert varies on the action required to achieve maximum vertical separation between your aircraft and the intruder. See Table 3B-107 for Aural Alert Messages. Intruders become a threat and an RA will be issued when the limits in Table 3B-109 are exceeded.

(5) Resolution Advisory Display. RA maneuver guidance symbols are red and green arcs superimposed on the vertical speed scale of the vertical speed indicator.

Two types of Resolution Advisories may be displayed, a preventive and a corrective. A preventive advisory indicates a vertical speed range or pitch that is to be avoided while maintaining your present flight path. A corrective advisory indicates a necessary change in flight path by displaying a vertical speed range or pitch to be flown to. Either advisory serves to ensure that the maximum separation between your aircraft and an intruder is maintained. Refer to Table 3B-110.

Table 3B-109. Resolution Advisory Chart

ALTITUDE (FEET)	SECONDS TO CPA
Below 900 AGL	RA not issued if descending
Below 1100 AGL	RA not issued if climbing
1000 – 2350 AGL	15
2350 AGL – 5000 BARO	20
5000 – 10,000 BARO	25
10,000 – 20,000 BARO	30
20,000 – Above BARO	35

Table 3B-110. Resolution Advisory Inhibits

Radio Altitude	Resolution Advisory Status
Below 1450 FT AGL	INCREASE DESCENT RA inhibited
Below 1000 FT AGL descending; Below 1200 FT AGL climbing	DESCEND RA inhibited
Below 900 FT AGL descending; Below 1100 FT AGL climbing	All RA's inhibited 9TA ONLY) and TA Aural Message inhibited.

(a) Preventive Advisory. The preventive advisory is an RA that occurs when the TCAS has determined that a threat exists but the current vertical speed or pitch will result in sufficient separation from the intruder. The general conditions for a preventive advisory occur when the intruder is within 300 to 800 feet (relative altitude), the range separation is decreasing, and there is approximately 25 seconds to the closest point of approach. The RA display will show a red vertical-speed arc indicating speeds or pitches to avoid. No other action is advised.

(b) Corrective Advisory. This is an RA that occurs when the TCAS has determined that the flight crew should take action to change vertical speed or pitch to avoid an intruder.

The advisory occurs when the threat aircraft is within 300 feet (relative altitude), the range separation is decreasing, and there is approximately 25 seconds to the closest point of approach. The TCAS will provide the flight crew with a recommended vertical speed or pitch to provide maximum aircraft separation at the closest point of approach. The corrective advisory consists of one or two red arcs and a green arc. As with the preventive advisory, the red represents vertical speed or pitch ranges that are to be avoided.

The pilot should act on the corrective advisory command within approximately 5 seconds after it is issued. Strengthened (increased climb or increased descents) resolution advisories or reversals represents more urgent situations and should be acted upon within not more than 2.5 seconds.

NOTE

The RA (either preventive or corrective) may downgrade to a TA when the intruder begins diverging from your own aircraft. When the RA changes to a TA, the vertical speed maneuver guidance arcs are removed and the aural message, "Clear Of Conflict" is annunciated.

g. Pop-Up Traffic. When no TA or RA situation exists for a climb, the display will appear as shown in Figure 3B-145*.*

When an RA or TA is issued, a display of all intruders within range pops up on the indicator and continues to be displayed until all TA's and RA's clear. The display will revert to showing VERT SPEED X 1000 FPM when clear.

h. Full Time Traffic. When the full time mode is selected, the VERT SPEED X1000 FPM legend is removed and the own-aircraft symbol, range ring, and range legend are continually displayed as shown in Figure 3B-146. If no traffic is present, the display will be the same except for the absence of the traffic symbols.

i. TA Only. In the TA-only mode the display will appear as shown in Figure 3B-147. The TA only mode can be manually selected on the transponder/TCAS control panel, or automatically in certain situations such as when below 1100 feet AGL during a climb or 900 feet AGL during a descent. The display will show the ONLY TA flag in message slots 1 and 2 and that the 6 nm range is selected.

Figure 3B-145. Full Time Traffic Operational Situation

Figure 3B-146. TA ONLY Operational Situation

NOTE

The TA-ONLY mode does not identify RA intruders and will not generate corrective or preventive RA displays. If an RA threat level aircraft is present, the display will show it as a TA target when the TA-ONLY mode is selected.

j. Corrective RA. Figure 3B-148 shows a corrective RA display advising immediate action to provide maximum aircraft separation at CPA. The indication shows the flight path correction having been started. Your aircraft is descending through 650 fpm to exit the vertical speeds indicated by the red arc. Desired vertical speed is indicated by the green arc, 1500 to 2000 feet per minute, down.

The maneuver is being performed to avoid the threat traffic indicated by the solid red square. The traffic is at 1/2 mile and 12 o'clock, 200 feet above your altitude and level.

At the same time this traffic was upgraded from a TA to a RA display, the aural alert "Descent, Descent, Descend" would have been annunciated.

Proximate traffic is also shown on this display. The solid diamond at 11 o'clock and 3.5 miles is 300 feet above your own altitude and descending. It poses no present threat, but is within the 6-mile, ±1200 feet relative altitude range. The other proximate traffic is at 2 o'clock and 4 miles, 500 feet below your altitude and climbing. It does not pose a present threat.

Two corrective commands may be issued if the initial corrective command does not provide the desired aircraft separation. When the threat aircraft maneuvers in a direction that results in a conflict if your own aircraft continues with the previously recommended maneuver these will occur.

An increase advisory, either climb or descend at 2500 fpm to 3000 fpm, will occur if the previous 1500 fpm to 2000 fpm rate of climb or descent is no longer adequate. This display will be accompanied by an aural annunciation of, "Increase Climb, Increase Climb" or "Increase Descent, Increase Descent" as appropriate for the advisory.

A reversal advisory, a climb advisory after a descend advisory, or a descend advisory after a climb advisory will occur if the TCAS determines that the initial advisory should be reversed. An example of when this advisory would occur would be when the intruder causing the initial climb advisory was above you descending into your aircraft's flight path, then alerted its flight path to present a new conflict if your aircraft were to continue to climb.

Figure 3B-147. Corrective RA Operational Situation

Reversal advisory displays will also initiate an aural annunciation of "Climb, Climb Now; Climb, Climb Now" or "Descend, Descend Now; Descend, Descend Now."

k. Preventive RA. Figure 3B-148 shows a preventive RA display. Your aircraft is descending at 1700 fpm. The red arc advises that you should not climb at any vertical speed to avoid the threat aircraft at 12 o'clock and 600 feet above you. When this traffic was upgraded from a TA to a RA display an aural annunciation of "Monitor Vertical Speed, Monitor Vertical Speed" would have been heard.

Proximate traffic is also shown in this display. The solid diamond at 11 o'clock and 3.5 miles is 700 feet above your own altitude and descending. The other proximate traffic at 2 o'clock and 4 miles is 100 feet below and climbing. Neither of these intruders poses a threat.

If the threat aircraft maneuvers to cause a new conflict before the RA clears, a corrective RA may be issued, over-riding the preventive RA.

l. No-Bearing Messages. When an intruder is detected but no bearing can be determined for the aircraft, a no-bearing message is displayed in slot 3 (and slot 4 if two, or more aircraft produce this situation; highest priority will be displayed first). A No Bearing Message is displayed in Figure 3B-149. The yellow TA indicates that the intruder is causing a traffic alert. The 1.2 indicates a distance to the intruder of 1.2 miles.

The 00 indicates that the intruder is level at your own altitude. An RA No Bearing Message, displayed in red, would be interpreted the same.

m. Clear of Conflict. When the range of an intruder responsible for causing an RA begins to increase, its conflict is considered to be resolved. If more than one intruder is involved in an RA, all conflicts must be resolved before the clear-of-conflict message will be issued. When this occurs, "Clear of Conflict" will be annunciated.

n. Failure Indications.

(1) Figure 3B-150 shows a TCAS flag, indicating failure of the TCAS and no range ring is displayed. Normal vertical speed operation is not affected. If the display is a result of a self-test being completed, the aural message, "TCAS System Test Fail" will be annunciated.

(2) Figure 3B-151 shows an RA and a V/S flag indicating failure of the vertical speed indicator. If

the vertical speed function of the indicator has failed, it can display no vertical speed commands, thus no RA maneuvers can be commanded. Therefore, the RA flag is also displayed

Figure 3B-148. Preventive RA Operational Situation

Figure 3B-149. No-Bearing Message Operational Situation

Figure 3B-150. TCAS Failure Indication Display

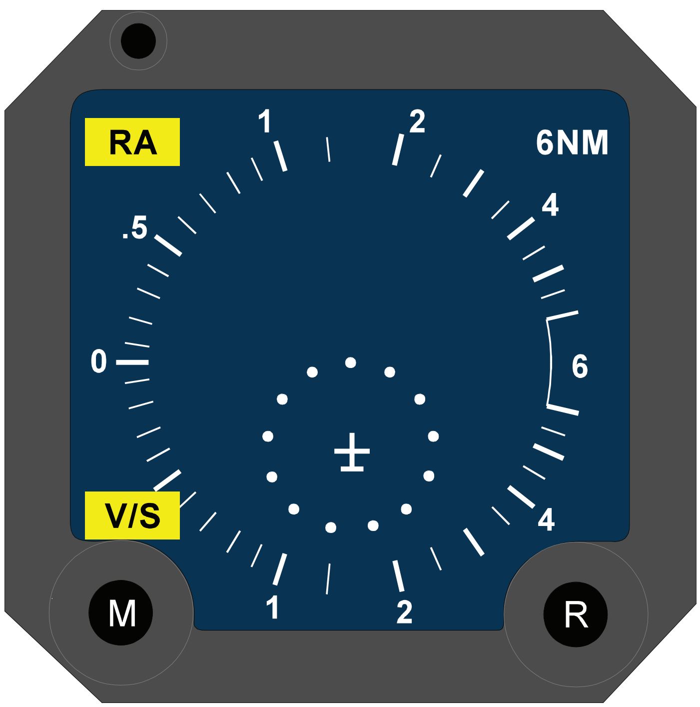


Figure 3B-151. Vertical Speed Indicator Failure

o. TCAS System Test. Self-test is initiated by selecting **TEST** on the transponder/TCAS control panel. While in the self-test mode normal operation of the TCAS is suspended. On the self-test display in Figure 3B-153, this test pattern is displayed on the vertical speed/TCAS indicator for a few moments. When the self-test is activated, it will also cause transponder self-test indications on the control panel. The squawk code digits display all 8's and the **FAIL** indicator lights momentarily. If the TCAS system passes the internal self-test, the aural message "TCAS System Test Okay" is annunciated. If the TCAS system fails, the message "TCAS System Test Fail" will be annunciated and the TCAS flag will be in view.

p. Operating Procedures. There are no particular preflight procedures to be performed on the TCAS. The only warmup time required is about 10 seconds after application of primary power for the unit power supplies to come to full voltage and the computer circuits to be reset to initial operating conditions.

NOTE

The average RF output power of the TCAS is below the minimum allowable for human exposure. The system may be operated normally on the ground without danger to personnel in the vicinity.

When executing takeoff, the 5 nm range and ABOVE scan are used. This will allow intruders at altitudes up to 9900 feet above you to be detected during takeoff and climbout. The range will keep distant intruders from cluttering the display at the time your aircraft is in areas of high traffic density, such as airport traffic areas. During the takeoff roll and initial climb, the display will indicate TA ONLY due to the inhibit to 1100 feet AGL in the climb.

(1) The following steps may be performed any time before system operation is required.

1. Select **STBY** on transponder/TCAS control. Power is applied to the transponder and TCAS any time the related primary power circuit breaker is closed. There is no off position.

2. Set assigned ATC squawk code for transponder on transponder/TCAS control.

3. Select **ALT**.

4. Select transponder **1**.

5. Select 5 nm range.

(2) To initiate self-test, perform the following:

1. Select **TEST**, then release to **STBY** (spring loaded) on transponder/TCAS control. Observe the transponder test of **8888** on the code display window and the YELLOW fail light illuminated.

2. Vertical speed/TCAS indicator will show traffic test pattern and TEST on indicator.

Figure 3B-152. TCAS System Test

3. At the end of test sequence an aural message "TCAS System Test Okay" or "TCAS System Test Fail" will be annunciated. If the **FAIL** light stays on it denotes a failure in the transponder or units monitored by the transponder. **FAIL** illuminates for one second to verify operation of the light and test mode in the transponder. Transponder code digits will display 8888 for 1 second to verify that all digit segments will illuminate.

q. Normal/In-Flight Operation. TA/RA is the normal operational mode, the system automatically inhibits RA displays when the aircraft if below 900 feet AGL on approach or 1100 feet AGL on climbout.

(1) Takeoff.

1. During the Line-Up check, select **1** and **TA/RA**.

2. Select 5 NM Range and ABOVE.

(2) Climb. Select 10 NM and ABOVE.

(3) Cruise. Select 20 NM and Normal (neither ABV nor BLW).

(4) Descent/Arrival. Select 10 NM and BELOW.

(5) Landing. Select 5 NM and BELOW.

(6) Post Flight. Place the Transponder in STBY mode as soon as practical after a landing is completed.

r. Alternate Operating Procedures. The following are suggested alternate operating procedures for use in event a TCAS flag is displayed on the vertical speed indicator, or the **FAIL** indicator on the transponder/TCAS control panel is lit. RA's cannot be displayed so the RA flag will also be displayed.

(1) V/S and RA Flags Displayed.

1. Select **TA ONLY.**

2. Traffic display will provide information, including TA's relative to intruders in your area.

WARNING

Do not maneuver the aircraft solely with reference to information on the traffic display.

(2) RA Flag Displayed. Appearance of this flag on the vertical speed indicator indicates failure of the RA functions of the TCAS. Follow the same procedure as in r(1) above.

(3) TCAS Flag Displayed. Appearance of this flag indicates failure of some part of the TCAS system. This includes the associated display systems as well as the units generating the major TCAS functions and signals.

1. Verify that **ATC FAIL** indicator is not lit. If lit, switch to the number 2 transponder. If not lit, continue with the following procedures.

2. Select **TA**.

WARNING

Do not maneuver the aircraft solely with reference to information on the traffic display.

3. If TCAS flag is replaced by TA ONLY message, continue TCAS operation in TA mode.

4. If TCAS FAIL flag remains, select **XPDR** as TCAS is no longer available.

3B-35. LIGHTNING DETECTION SYSTEM (STORMSCOPE WX-1000E).

a. Description. The Stormscope system consists of three components that detect, locate, and map areas of vertical electrical discharge activity contained within thunderstorms. The antenna mounts externally to the aircraft and detects electrical discharges associated with thunderstorms over a 125,000 square mile area around the aircraft. The processor analyzes this information to aid in identification of valid electrical discharges from lightning and to determine range and azimuth for display in the cockpit. The analysis is completed in milliseconds. The location of a vertical electrical discharge associated with thunderstorm is plotted on the CRT display on the instrument panel as an individual discharge point (**+**).

b. Controls and Functions.

(1) Power/Brightness Control. Rotate to turn on the system and adjust the brightness of the display.

(2) Selector Buttons. The specific function of each button is displayed adjacent to the button in each operating mode.

c. Normal Operation.

(1) Self-Test. Each time the system is turned on it will automatically cycle through a series of self-tests which ensure that all major functions are operating properly. These tests, which take approximately 15 seconds to complete, check antenna reception, processor circuitry calibration, memory and microprocessor function, and proper operation of the options. After proper operation has been verified by the self-test program, a confirmation message, ALL TESTS ARE OK, will display in reverse video. This message will remain on the display for approximately 3 seconds and then will be replaced automatically with MAIN MENU.

If the system fails any of the internal tests, an error message will appear indicating which test failed and which functions may be inoperative. In most cases, all other systems will continue to operate. If continued operation is possible, the message, PRESS ANY KEY TO CONTINUE will display.

When initially turned on, the system may complete its self-test program before the CRT comes on. In that case it is possible that the first message that will be seen is the main menu. This is normal operation.

If the weather screen is selected immediately, it is possible the advisory message FLAG will display where heading information is normally displayed. This usually means the gyro system has not yet come up to speed. FLAG should be replaced with heading information momentarily.

(2) Main Menu. The main menu provides access to the two weather mode views and additional system functions, including checklists, time/date information, options, and navaid display. To select a specific menu item, press **NEXT** button on the display until the desired item is highlighted and press the **GO** button to view the selected menu item.

(3) Weather Modes. Two weather mode views are available from the main menu by pressing either the 360° or the 120° button. The symbol ➔ means to "go to." When the weather mode is initially selected, it will always be in the 200-nm range. Pressing the button beside the range setting will cycle through the additional range selections from 200 nm to 100 nm to 50 nm to 25 nm and back to 200 nm. The 25-nm range is indicated by a solid ring to advise of close proximity to potential thunderstorms. Either view can be selected from the main menu or the opposite view. When changing from one view to another, the range remains constant.

The 120° view provides an expanded view so thunderstorm information is displayed in greater detail. Refer to Figure 3B-154.

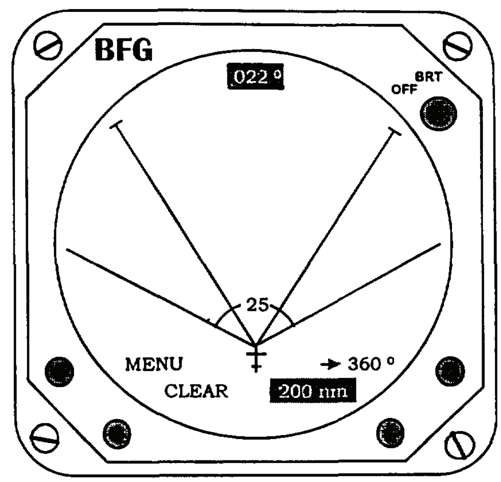


Figure 3B-153. 120° Weather Mode

Press the **CLEAR** button to erase all weather data from the display and system memory. The intensity of a thunderstorm can be identified by the speed with which the discharge points appear. The system continually receives and processes new electrical discharge information. Monitor this by pressing the clear button often. The more intense the storm, the faster the discharge points reappear.

Multiple discharges which appear as clusters are indicative of thunderstorm activity. A large number of discharge points indicate a faster rate of occurrence and, therefore, a more severe thunderstorm. Fewer discharge points indicate a smaller, but not necessarily, weaker, cell. Thunderstorm conditions change rapidly and monitoring their activity over a period of time by use of the **CLEAR** function is recommended. Any grouping of discharge points within the 25-nm range is cause for immediate avoidance. The Weather Mode should always be used when IMC and thunderstorms are forecast or suspected.

WARNING

The Stormscope system should never be used to attempt thunderstorm penetration. Army operating procedures require aircrews to avoid thunderstorms by at least 20 miles.

CAUTION

Persistent clusters of two or more discharge points after clearing the screen indicate thunderstorms. There are several atmospheric phenomena that can cause isolated discharge points.

Additionally, should the heading stabilization fail, it is necessary to press the **CLEAR** button for properly oriented data following an aircraft heading change.

Press the **MENU** button to return to the main menu.

NOTE

The date is set before the time.

(4) Time/Date Mode. The TIME/DATE mode can be selected only from the main menu. The time/date mode menu displays four items: stopwatch, elapsed time, time of day, and day, month, and year. Refer to Figure 3B-155. When first selecting the time/date mode, the stopwatch digits will be highlighted. To use the stopwatch function, press the **START** button to start or stop. Pressing the **RESET** button will immediately reset the timer. To use the elapsed time feature, press the **NEXT** button to highlight the elapsed time digits and press the **START** button to start or stop the counter. Pressing the **RESET** button will reset the elapsed timer.

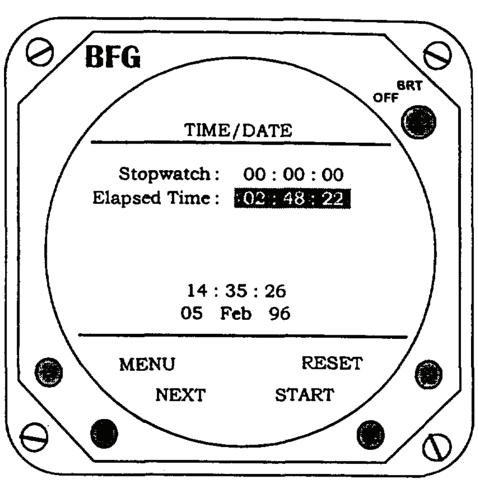


Figure 3B-154. Time/Date Mode

To set the current date or the correct time, press the **NEXT** button to highlight the digits to be changed. Press the **UP** or **DOWN** button to step the digits to the proper value. When either the time or date are highlighted, the **RESET** and **START** button legends are replaced with **UP** and **DOWN**.

(5) Options Mode. The options mode can only be selected from the main menu. The system continuously self-tests many functions. Refer to Figure 3B-156. Results are indicated by CONTINUOUS TEST: OK or FAULT. CONTINUOUS TEST: OK indicates that all internal self-test items have been operating properly. The continuous self-test is intended to advise only of major component failures. The pilot initiated self-test is more extensive than the continuous self-test and is recommended as a check on system operation whenever thunderstorm activity is noted on the display. Press the **TEST** button when in the options mode to manually initiate the test.

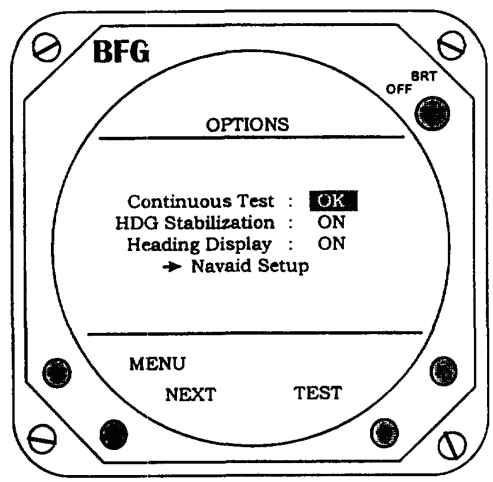


Figure 3B-155. Options Mode

The system will initially power up with the heading stabilization feature on. Should the aircraft heading gyro fail, the heading stabilization feature can be turned off. To turn the heading display on or off, press the **NEXT** button to highlight heading display and press **ON / OFF** as appropriate. Refer to Figure 3B-157. When on, the heading of the aircraft will appear as a digital indication at the top of the display when in either weather mode.

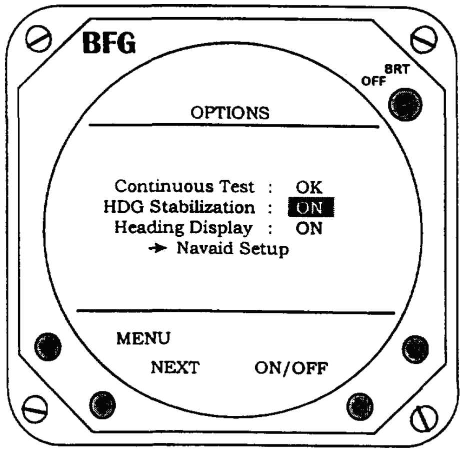


Figure 3B-156. Heading Options

(6) Navaid Option. This option creates a weather avoidance and navigational view. Refer to Figure 3B-158. Using data from the KLN-90B, this option provides simultaneous display of both thunderstorm and flight information on the system screen. The course line, selected waypoints, and a course deviation indicator are graphically displayed. Up to ten waypoints may be display with the selected nautical mile range. The CDI is calibrated to indicate the course deviation up to 5 nautical miles on either side of the course line. Up to six user-selectable data items can be displayed. The navaid option is selected from the main menu. Display range, ground speed, estimated time en route, bearing, crosstrack error, and estimated time of arrival are automatically displayed. The data or its position can be changed through the Navaid Setup function on the Options menu.

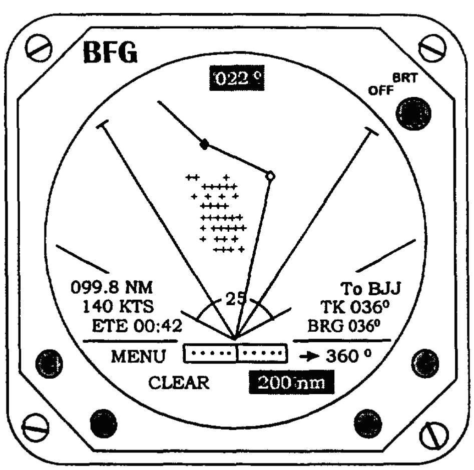


Figure 3B-157. Navaid Option

The Navaid Setup grid lists 14 data items and includes a blank space. Refer to Table 3B-111 for data items definitions. Up to six items can be displayed on the weather-mapping screen. To select an item from the grid, move the highlight by pressing the **NEXT** button. Refer to Figure 3B-159. The data items available for selection are dependent upon the specific information provided by the KLN-90B receiver. If an item on the grid is not available from the receiver, that grid space will include an asterisk.

Table 3B-111. Navigation Data Items

ABBR	USER SELECTIONS
Brg	Bearing to Active Waypoint
ETA	Estimated Time of Arrival
ETE	Estimated Time En Route
GS	Ground Speed
Lat	Latitude
Long	Longitude
MESA	Minimum Enroute Safe Altitude
MSA	Minimum Safe Altitude
Mvar	Magnetic Variation at Present Position
Rng	Range to Active Waypoint
Time	Stormscope System Stopwatch
Trk	Track
WPT	Waypoint Identifier
XTK	Crosstrack Error

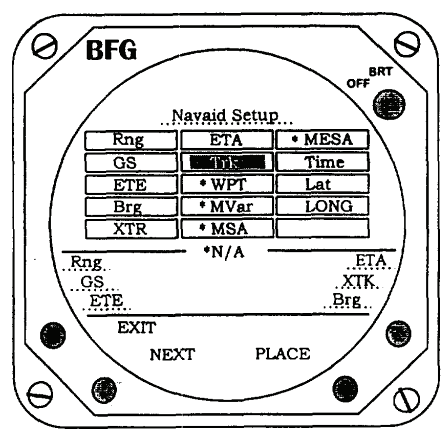


Figure 3B-158. Navaid Setup – Select

To place the item into one of the six positions on the screen, press the **PLACE** button. This places the data item in the upper left position in the legend area. To move the item to another position, press the **MOVE** button. Each additional press of the **MOVE** button advances the item counterclockwise. Refer to Figure 3B-160.

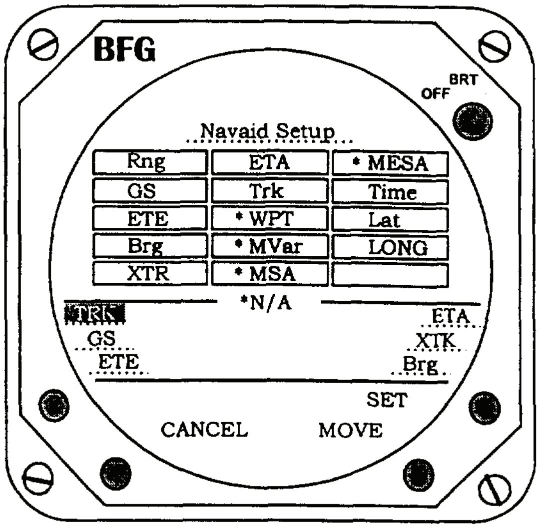


Figure 3B-159. Navaid Setup – Move

To set the display position of a highlighted item, press the **SET** button. This establishes the position of the data item display on the weather screens. After pressing the **SET** button, the highlight will return to the next data item on the grid. To return the data item to the grid without setting, press the **CANCEL** button. This will return the data item highlight to the grid. Since the data item was not set to the legend area, any data item previously occupying the position will remain there. To select additional data items, repeat the sequence of **NEXT** to highlight the item, **PLACE** it from the grid to the legend area, **MOVE** it to the desired position on the legend area, and **SET** it. To replace a data item previously set in position, follow the same sequence. Pressing the **SET** button when a highlighted data item is in an occupied legend position causes the new item to replace the previous item.

To erase an item from the legend area, press **NEXT** to highlight the blank space on the grid, **PLACE** it to the legend area, **MOVE** it in the legend area to the position to be erased, and **SET** it.

Press the **EXIT** button to return to the Options Menu. The press **MENU** to return the Main Menu including the weather options.

(7) Error Messages. Most common errors and malfunctions are indicated on the display screen. These messages enable service personnel to diagnose and correct the problem. If continued operation is possible, a message to press any key to continue operation will be displayed. When the GPS receiver fails to acquire a consistent signal and is not certain of its position, the message NAV FLAG will appear in place of the CDI. Navigational data will not be displayed if the receiver indicates a flag condition. In conditions where the GPS receiver determines its position error to be greater than 1.7 nm, a W (warning) will appear next to the affected data items. The system will display a stuck microphone message when the microphone is keyed in excess of two minutes.

3B-36. GROUND COLLISION AVOIDANCE SYSTEM.

WARNING

The ground collision avoidance system will provide little, if any, warning for flight into precipitous terrain approaching a sheer wall if there is little gradually rising terrain before reaching the steep terrain.

The ground collision avoidance system will provide no warning for stabilized descent in the landing configuration into terrain, unless the aircraft is following an operating electronic glideslope or a correct minimum descent altitude has been set on the radio altimeter (activating mode 6).

a. Description. The Ground Collision Avoidance System (GCAS) is provided to aid the flight crew in terrain avoidance. Figure 3B-160 shows the ground collision avoidance system controls and indicators.

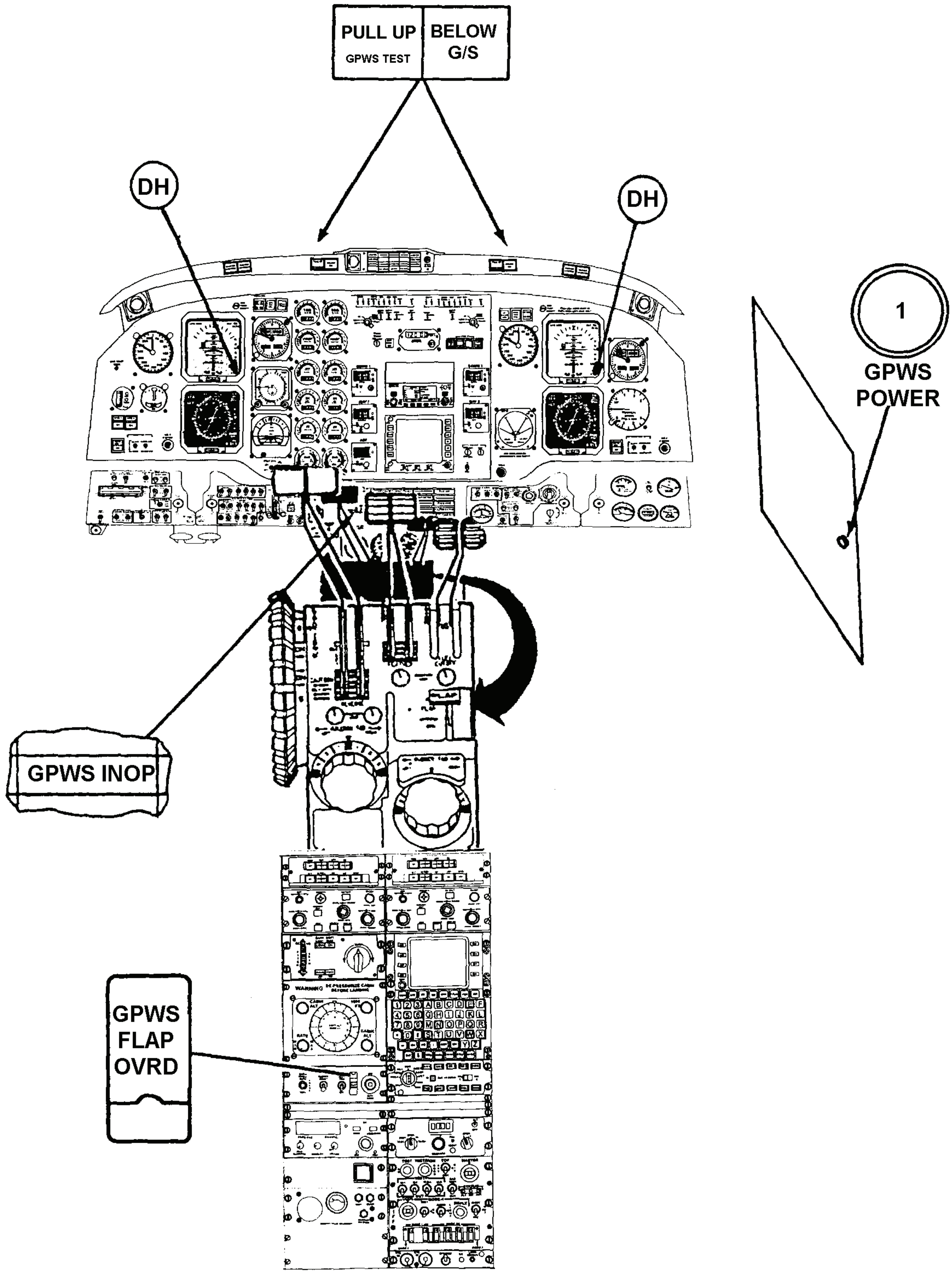


Figure 3B-160. Ground Collision Avoidance System Control and Indicators

The GCAS is a completely automatic system (requiring no input from the crew) which continuously monitors the aircraft's flight path at altitudes of between 50 and 2450 feet Above Ground Level (AGL).

The system provides visual and aural advisory/warning messages to the crew in the event the aircraft is flown along a projected flight path that would result in contact with the terrain under any of six modes of operation.

NOTE

The operating temperature range of the computer is -15 °C to 71 °C.

When operating in temperatures below -15 °C, the system may be unreliable.

All alert/warning signals are inhibited below 50 feet AGL.

System messages always precede the "Whoop, Whoop" aural tone and "Pull Up" warnings, thus allowing the crew time to identify and correct the specific flight situation. The system messages and warnings are discussed in the various mode descriptions.

In all GCAS warning modes, the warnings cease and the system resets when the pilot establishes a positive pull up and climb. The system consists of a ground collision avoidance system computer located in the nose avionics compartment, pilot's and copilot's glareshield warning lights, flight compartment speakers/headsets, a flap override switch, a **GPWS INOP** annunciator light, and a system circuit breaker, placarded **GPWS POWER**, located on the copilot's sidewall circuit breaker panel.

b. Controls, Indicators, and Functions.

(1) GCAS Glareshield Switch-Indicators. The pilot and copilot are each provided with two GCAS system switch-indicators located on their respective sides of the glareshield. The left switch-indicator is red and is placarded **PULL UP** in large letters and **GPWS TEST** in smaller white engraved letters below. The right switch-indicator is yellow and is placarded **BELOW G/S**. The **PULL UP** indicator lights will flash when the threshold activation limits of modes 1, 2, 3, or 4 have been exceeded. The **BELOW G/S** indicator lights will illuminate continuously when the threshold activation limits of mode 5 have been exceeded. Pressing the **BELOW G/S** switch-indicator when below 1000 feet AGL will deactivate the deviation below glideslope mode. The glideslope mode will be re-armed when the aircraft climbs back through 1000 feet AGL. Pressing the **PULL UP, GPWS TEST** switch-indicator will activate the GCAS self-test sequence.

(2) GCAS Aural Warning Indicators. The following is a list of aural indications. Due to the possibility of activating more than one condition at a time, the following warning priority has been established. A voice annunciator of a higher priority will immediately override a lower priority message in progress. A lower priority message will function only upon the cessation of a higher order warning.

1. “Whoop, Whoop, Pull Up" (modes 1 and 2).
2. "Terrain" (mode 2).
3. "Too Low Terrain" (mode 4).
4. "Too Low Gear" (mode 4).
5. "Too Low Flap" (mode 4).
6. "Minimums" (mode 6).
7. "Sink Rate" (mode 1).
8. "Don't Sink" (mode 3).
9. "Glideslope" (mode 5).

(3) GCAS Flap Override Switch. A guarded switch placarded **GPWS FLAP OVRD**, located on the pedestal extension, provides a means of disabling the "Too Low Flap" aural warning to facilitate landing with the flaps in the UP position. The GCAS "Too Low Flap," aural warning will not be activated if the flap is in the **APPROACH** or **LANDING** positions (40° or greater).

(4) GCAS System Inoperative Caution Annunciator Light. Illumination of the cautionary (yellow) annunciator light placarded **GPWS INOP**, located on the caution/advisory annunciator panel, warns the flight crew that the GCAS is not functional.

c. Normal Operation.

(1) Turn-On Procedure. The GCAS is operable when the following conditions have been met:

1. Battery switch – **ON**.
2. Inverter switch – **NO. 1** or **NO. 2**.
3. **AVIONICS MASTER POWER** switch – **ON**.
4. **GPWS POWER** circuit breaker – In.

5. **GPWS INOP** annunciator light – Extinguished.

(2) GCAS Self-Test.

1. Ensure the Flap selector is UP, pilot's or copilot's **PULL UP / GPWS TEST** switch-indicator (glareshield) – Press and hold. Check for the following indications:

   a. Pilot's and copilot's **BELOW G/S** switch-indicators (glareshield) – Illuminated.

   b. **GPWS INOP** annunciator light – Illuminated.

   c. Warning voice (headsets/ speakers) will say "Glideslope" once.

   d. Pilot's and copilot's **PULL UP** switch-indicators will start flashing after approximately 1 second, then the "Whoop, Whoop, Pull Up" warning voice will be heard.

   e. After several repetitions the "Pull Up" voice will stop.

2. Pilot's and copilot's **PULL UP / GPWS TEST** switch-indicator (glareshield) – Release. Check for the following indications:

   a. "Pull Up" voice will stop, and **PULL UP** light will extinguish.

   b. Pilot's and copilot's **BELOW G/S** switch-indicators (glareshield) – Extinguished.

   c. **GPWS INOP** annunciator light – Extinguished.

NOTE

The self-test may be accomplished while airborne if the radio altitude is above 1000 feet AGL and the landing gear is in the UP position.

(3) Response to Warnings.

(a) When a warning occurs, the flight crew should initiate corrective action to remove the cause of the warning.

(b) When a **PULL UP** warning occurs, immediately apply engine power, establish a positive climb attitude, and climb at the maximum practical rate until the warnings cease or terrain clearance is assured.

NOTE

Best climb angle will result in maximum ground clearance in the shortest horizontal distance. Increase pitch attitude smoothly. Large thrust increases may result in a nose-up pitching tendency requiring forward column pressure and trim.

When flying under daylight VFR, and a warning threshold is deliberately exceeded or encountered due to specific terrain at certain locations, the warning may be regarded as cautionary and the approach may be continued.

Where operations at specific locations must be conducted in close proximity to terrain, or a flaps up approach is flown, the GPWS FLAP OVRD switch may be set to OVRD to desensitize the terrain closure rate warning mode (mode 2). Reset the GPWS FLAP OVRD switch after landing or immediately after making a go-around.

(4) GCAS Modes of Operation. The GCAS operates in the following six modes of operation:

(a) Excessive Sink Rate (Mode 1). Mode 1, Figure 3B-162, provides visual and aural warnings for excessive rate of descent with respect to terrain when below 2450 feet AGL. When the aircraft penetrates the outer warning boundary, the "Sink Rate" aural warning will be given and repeated every 0.75 seconds, and **PULL UP** indicator lights on the glareshield will begin to flash. If the rate of descent is not corrected and the second boundary is penetrated, the "Whoop, Whoop, Pull Up" aural warning will sound. The excessive sink rate mode is independent of gear and flap configuration.

(b) Excessive Terrain Closure Rate (Mode 2). Mode 2, Figure 3B-163, provides visual and aural warnings for excessive terrain closure rate. The terrain closure rate mode is a function of inputs of airspeed, radio altitude and rate of change, barometric altitude, and gear and flap position. When the aircraft penetrates the outer warning area, the "Terrain" aural warning will sound twice, and the **PULL UP** indicator lights will begin flashing. If the excessive closure rate condition remains uncorrected and the inner warning boundary is penetrated, the "Whoop, Whoop Pull Up" aural warning will sound every 0.75 seconds. Upon climbing out of the inner warning boundary, the

"Terrain" aural warning will sound every 0.75 seconds, until the aircraft gains an additional 300 feet of barometric altitude.

During an approach with the gear or flaps extended, the 300-foot altitude gain function is inhibited. For altitudes below 700 feet AGL with gear and flaps extended, the "Pull Up" aural warning is replaced by the "Terrain" aural warning.

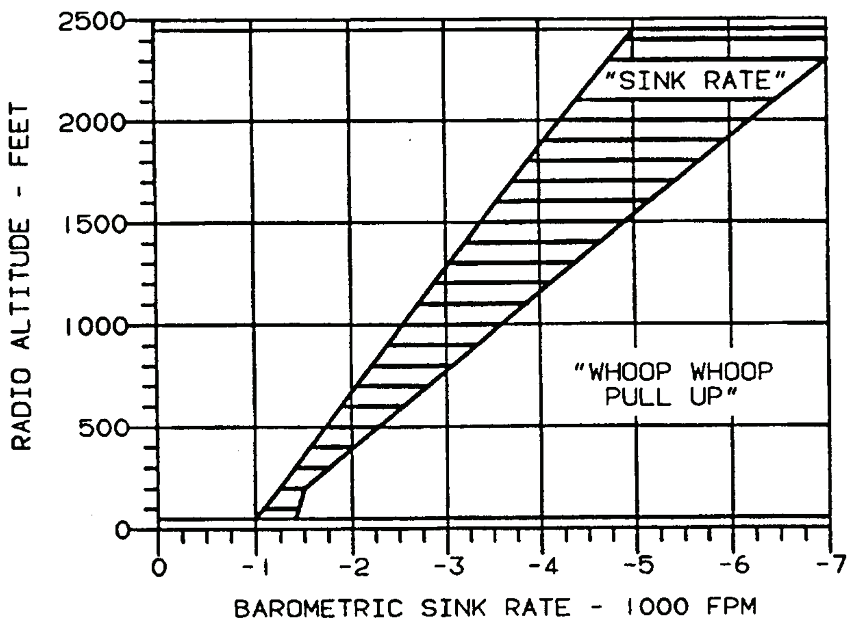


Figure 3B-161. Excessive Sink Rate (Mode 1)

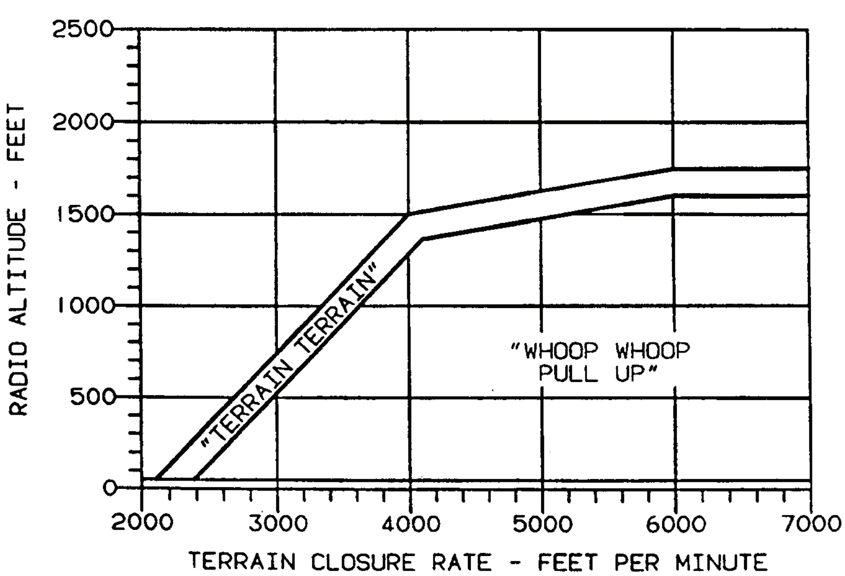


Figure 3B-162. Excessive Terrain Closure Rate (Mode 2) *(c) Descent After Takeoff (Mode 3).* Mode 3, Figure 3B-164, provides visual and aural warnings for altitude loss after takeoff or missed approach, before attaining 700 feet AGL. When the aircraft penetrates the warning boundary, a "Don't Sink" aural warning will sound and the **PULL UP** glareshield indicator lights will begin to flash. This message will be repeated every 0.75 seconds until a positive rate of climb is established. At this time the warning ceases but the computer continues to compare the aircraft's barometric altitude to the altitude where the initial descent began. If the aircraft should descend again before climbing to the initial descent altitude, another "Don't Sink" warning will be generated based on the original descent altitude. The warning threshold is when approximately 10% of the initial descent altitude has been lost. This mode is active from 65 feet to 700 feet AGL during takeoff or when either flaps or gear are retracted during a missed approach from below 200 feet AGL. Above 700 feet AGL the computer automatically switches to the terrain clearance mode (mode 4).

(d) Terrain Clearance – Gear Up (Mode 4a). Mode 4a, Figure 3B-165, provides visual and aural warnings for terrain clearance with gear up. The terrain clearance mode with gear up is activated upon climbing through 700 feet AGL after takeoff. When the boundary is penetrated above approximately 175 KIAS the "Too Low – Terrain" aural warning will be sounded and the **PULL UP** glareshield indicator lights will begin to flash. When the boundary is penetrated below approximately 175 KIAS the "Too Low – Gear" aural warning will be sounded and the **PULL UP** glareshield indicator lights will begin to flash. In either case, the warnings will be repeated every 0.75 seconds until the condition has been corrected.

Mode 4a is inhibited below 50 feet AGL for any gear or flap positions.

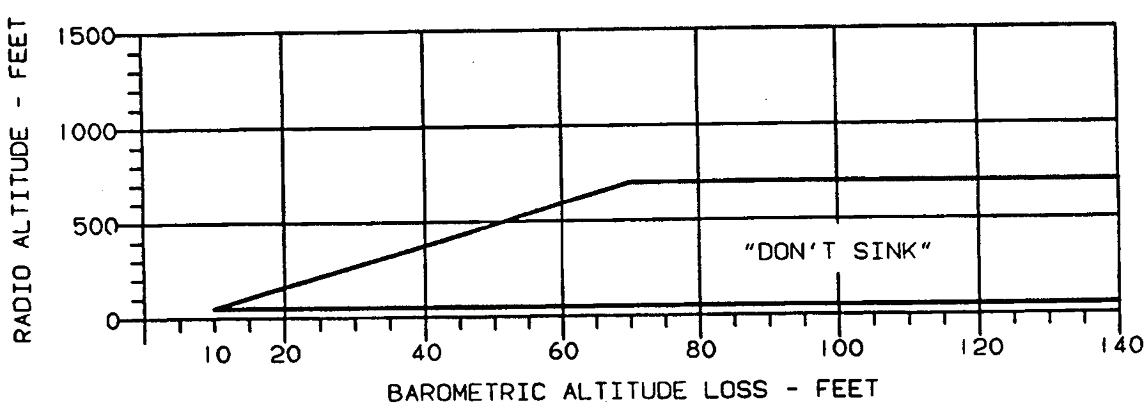


Figure 3B-163. Descent After Takeoff (Mode 3)

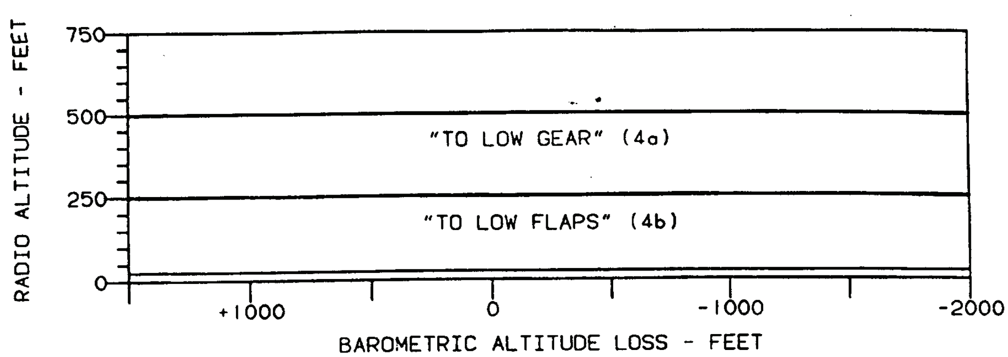


Figure 3B-164. Proximity to Terrain (Mode 4)

(e) Terrain Clearance – Gear Down, Flaps Up (Mode 4b). Mode 4b provides visual and aural warnings for terrain clearance with gear down and flaps less than 40%. When aircraft penetrates the warning boundary at a speed below approximately 145 KIAS with the flaps not extended, the "Too Low – Terrain" aural warning will be sounded and the **PULL UP** glareshield indicator lights will begin to flash.

In the event that the landing gear is extended and then retracted, at 200 feet AGL the "Too Low – Gear" aural warning will sound and the **PULL UP** glareshield indicator lights will begin to flash if the gear is still retracted at that time.

Mode 4b is inhibited below 50 feet AGL for any gear or flap position. The computer automatically switches from mode 4b to mode 3 whenever the boundary of mode 4b is passed in full landing configuration (gear and flaps down), or whenever the aircraft is below 50 feet AGL with the gear down.

(f) Descent Below Glideslope (Mode 5). Mode 5, Figure 3B-166, provides visual and aural warnings for descent below glideslope when making and ILS approach. When the aircraft penetrates the outer warning boundary while on an ILS approach, a "Glideslope" aural warning will be given softly and the **BELOW G/S** glareshield indicator lights will be continuously illuminated. If the inner warning boundary is penetrated, the "Glideslope" aural warning repeats faster and at a higher audio level. The glideslope advisory alert may be canceled anywhere below 1000 feet AGL by pressing the **BELOW G/S** glareshield switch-indicator. The deviation below glideslope mode will automatically be reset by climbing above 1000 feet AGL.

(g) Descent Below Selected Radio Altitude (Mode 6). Mode 6 provides aural warning for descending below the radio altitude decision height selected on the radio altimeter indicator with the decision height marker for altitudes between 1000 feet AGL and 50 feet AGL with the landing gear down.

When the aircraft descends below the selected radio altitude the "Minimums" aural warning will sound. The mode will not function again until 1000 feet AGL or 50 feet AGL have been transitioned or the landing gear has been cycled up or down. There are no glareshield warning lights associated with Mode 6.

d. Emergency Operation. If any emergency procedure makes it necessary to land with the gear up or some situation makes it necessary to disable the **GCAS**, pull the **GPWS POWER** circuit breaker located on the copilot's sidewall circuit breaker panel.

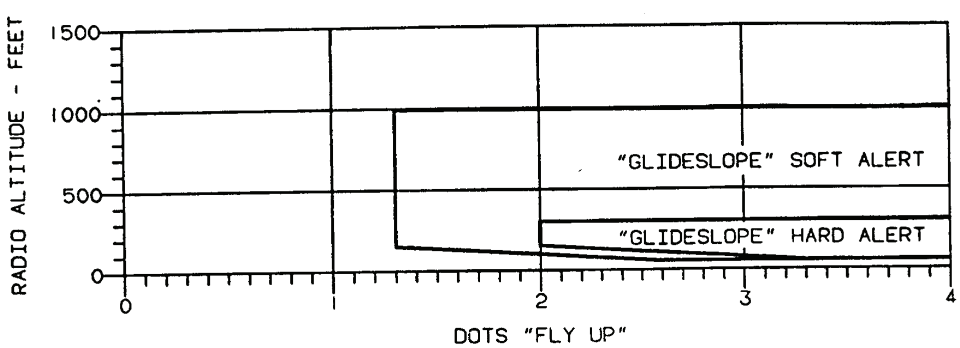


Figure 3B-165. Descent Below Glideslope (Mode 5)

CHAPTER 3C
AVIONICS F3

Section I. GENERAL

3C-1. DESCRIPTION.

This section covers electronic equipment installed in the C-12F3 aircraft. It provides a brief description of each system, associated controls, indicators, and operating procedures. ANG aircraft are equipped with HF radio provisions only. The HF radio equipment, cockpit voice recorder and flight data recorder discussed are not installed in the ANG aircraft.

3C-2. AVIONICS EQUIPMENT CONFIGURATION.

The communication group is comprised of an interphone system connected to a dual audio control panel with separate controls for the pilot and copilot that interface with VHF, UHF, and HF communication units. The navigation group provides the pilot and copilot with instrumentation to establish and maintain an accurate flight course and to make an approach under Instrument Meteorological Conditions (IMC). Equipment for determining aircraft altitude, position, range and bearing to destination, groundspeed, and drift angle is installed. A flight control system is provided with autopilot capabilities. Separate flight director indicators serve the pilot and copilot. A transponder, emergency locator transmitter, cockpit voice recorder, crash data recorder with an integral underwater acoustic beacon (pinger), Ground Collision Avoidance System (GCAS), and Data NAV weather radar are also installed.

3C-3. POWER SOURCE.

a. DC Power. The avionics equipment receives dc power from the 28 Vdc buses. These buses feed through three 30-ampere circuit breakers on the avionics circuit breaker panel to respective avionics power relays. Each power relay connects power to circuit breakers that protect the individual avionics equipment. A 5-ampere circuit breaker, placarded **AVIONICS MASTER**, feeds power to the **AVIONICS MASTER POWER** switch on the pilot's left outboard subpanel. The **AVIONICS MASTER POWER** switch controls three avionics power relays. If the switch is **OFF**, the relays remain open withholding power from avionics equipment. DC (battery) power for isolated operation of the UHF and COMM 1 radios and pilot's audio system is provided via an auxiliary dc bus. Power to the auxiliary bus is provided through two aux power relays and is controlled by a two-position switch, placarded **DC AUX BUS,** located under the gang bar with the battery and generator switches. An external power receptacle is located under the right wing outboard of the nacelle.

b. AC Power Source. Two inverters sharing a common control switch, placarded **INVERTER NO. 1 / OFF / NO. 2**, on the pilot's outboard subpanel, supply single phase 26 Vac and 115 Vac power. Each 115 Vac circuit is protected by a 10-ampere circuit breaker and a backup 5-ampere fuse. Each 26 Vac circuit is protected by a 5-ampere circuit breaker. Separate 50-ampere current limiters on the main dc power panel supply dc power to operate the inverters.

Section II. COMMUNICATIONS

3C-4. COMMUNICATIONS EQUIPMENT GROUP DESCRIPTION.

The communication group is comprised of an interphone system connected to a dual audio control panel, with separate controls for the pilot and copilot which interface with VHF, UHF, and HF communication units.

3C-5. MICROPHONES.

Hand held, boom, and oxygen mask microphones can be utilized in the aircraft.

a. MIC NORMAL Switch. Selects boom or hand held microphone.

b. OXYGEN MASK Switch. Selects microphone in oxygen mask.

c. The MIC Push Switch. Control wheel/hand held microphone routes voice from microphone to selected transmitter when pressed.

3C-6. AUDIO CONTROL PANEL.

a. Description. A dual audio control on the instrument panel, shown as Figure 3C-1, serves both the pilot and copilot. This panel is equipped with two sets of identical controls. Separate speaker and interphone isolation amplifiers are provided so that either the pilot or copilot may transmit to the cabin speakers.

b. Controls, Indicators, and Functions.

(1) Pilot's ***COMM 1*** *Switch* – Selects very high frequency receiver.

(2) Pilot's ***COMM 2*** *Switch* – Selects very high frequency receiver.

(3) Pilot's ***HF*** *Switch* – Selects high frequency receiver.

(4) Pilot's ***UHF*** *Switch* – Selects ultra high frequency transmitter.

(5) Pilot's ***NAV 1*** *Switch* – Selects VOR audio.

(6) Pilot's ***NAV 2*** *Switch* – Selects VOR audio.

(7) Pilot's ***MKR BCN 1*** *Switch* – Receives audio from marker beacon.

(8) Pilot's ***MKR BCN 2*** *Switch* – Receives audio from marker beacon.

(9) Pilot's ***DME*** *Switch* – Receives DME audio.

(10) Pilot's ***TACAN*** *Switch* – Receives TACAN/DME audio.

(11) Pilot's ***ADF*** *Switch* – Receives ADF audio.

(12) Copilot's ***COMM 1*** *Switch* – Selects very high frequency receiver.

(13) Copilot's ***COMM 2*** *Switch* – Selects very high frequency receiver.

(14) Copilot's ***HF*** *Switch* – Selects high frequency receiver.

(15) Copilot's ***UHF*** *Switch* – Selects ultra high frequency transmitter.

(16) Copilot's ***NAV 1*** *Switch* – Selects VOR audio.

(17) Copilot's ***NAV 2*** *Switch* – Selects VOR audio.

(18) Copilot's ***MKR BCN 1*** *Switch* – Receives audio from marker beacon.

(19) Copilot's ***MKR BCN 2*** *Switch* – Receives audio from marker beacon.

(20) Copilot's ***DME*** *Switch* – Receives DME audio.

(21) Copilot's ***TACAN*** *Switch* – Receives TACAN/DME audio.

(22) Copilot's ***ADF*** *Switch* – Receives ADF audio.

(23) Copilot's ***XMTR*** *Selector* – Selects **COMM 1**, **COMM 2**, **HF**, **UHF**, **INTPH**, or **CABIN**.

(24) Copilot's ***AUDIO / SPKR*** *Switch* – Routes audio to overhead speakers.

(25) Copilot's ***VOICE / RANGE*** *Switch*.

(a) ***VOICE*** – Kills range, allows voice.

(b) ***BOTH*** – Allows both voice and range.

(c) ***RANGE*** – Kills voice, allows 1020 Hz range tone.

(26) ***INPH HOT / OFF*** *Switch* – Allows interphone communication between pilot and copilot without keying the MIC button.

(27) Pilot's ***VOICE / RANGE*** *Switch*.

(a) ***VOICE*** – Kills range, allows voice.

(b) ***BOTH*** – Allows both voice and range.

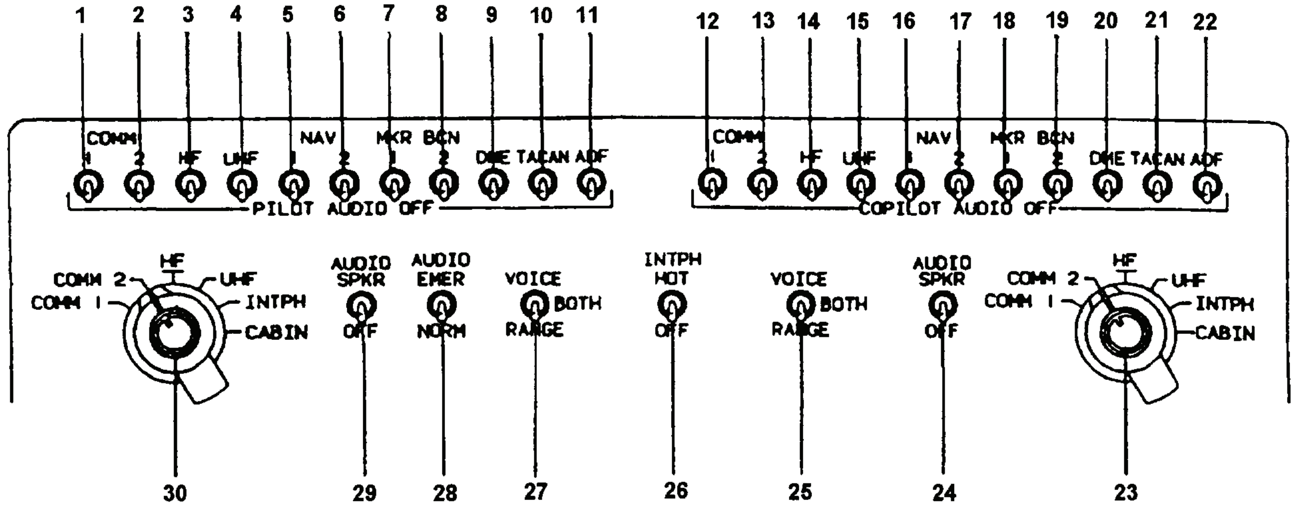
(c) ***RANGE*** – Kills voice, allows 1020 HZ range tone.

(28) ***AUDIO EMER / NORM*** *Switch.*

(a) ***NORM*** – Allows normal operation of the audio amplifier.

(b) ***EMER*** – Allows reception of all audio in headphones in the event of failure of audio amplifier.

(29) Pilot's ***AUDIO SPKR*** *Switch* – Routes audio to overhead speakers.



1. Pilot's COMM 1 Switch
2. Pilot's COMM 2 Switch
3. Pilot's HF Switch
4. Pilot's UHF Switch
5. Pilot's NAV 1 Switch
6. Pilot's NAV 2 Switch
7. Pilot's MKR BCN 1 Switch
8. Pilot's MKR BCN 2 Switch
9. Pilot's DME Switch
10. Pilot's TACAN Switch
11. Pilot's ADF Switch
12. Copilot's COMM 1 Switch
13. Copilot's COMM 2 Switch
14. Copilot's HF Switch
15. Copilot's UHF Switch
16. Copilot's NAV 1 Switch
17. Copilot's NAV 2 Switch
18. Copilot's MKR BCN 1 Switch
19. Copilot's MKR BCN 2 Switch
20. Copilot's DME Switch
21. Copilot's TACAN Switch
22. Copilot's ADF Switch
23. Copilot's XMTR Selector
24. Copilot's AUDIO/SPKR Switch
25. Copilot's VOICE/RANGE Switch
26. INTPH HOT/OFF Switch
27. Pilot's VOICE/RANGE Switch
28. AUDIO EMER/NORM Switch
29. Pilot's AUDIO SPKR Switch
30. Pilot's XMTR Selector

Figure 3C-1. Dual Audio Control Panel

(30) Pilot's ***XMTR*** *Selector* – Selects **COMM 1, COMM 2, UHF, HF, INTPH**, or **CABIN**.

c. Normal Operation.

(1) Turn On.

1. Aircraft dc power – **ON**.

NOTE

It is presumed the AVIONICS MASTER POWER Switch is ON and that normally used avionics circuit breakers remain pressed.

The circuit breakers of routinely used avionics systems are normally left pressed.

2. **AVIONICS MASTER POWER** Switch – **ON**.

(2) Receive.

1. **AUDIO SPKR** Switches (audio panel) – **SPKR**.
2. **AUDIO EMERG / NORM** Switch – **NORM**.
3. Move each audio panel select switch **ON** then **OFF**, separately, to verify audio output from speakers for each system and adjust volume.

NOTE

Audio panel switches and volume controls are routinely left in positions of normal use.

All audio volume controls are on the radio section of the instrument panel, except for controls to the HF, UHF, and TACAN systems located on the pedestal.

4. **AUDIO SPKR** Switch – **OFF**.

NOTE

Headphone audio will always be active regardless of SPKR / ON switch position.

5. Move each audio panel select switch **ON** then **OFF**, separately, to verify audio output from headphones for each system.

6. Audio panel select switches – Select switches **ON** as desired for communications.

(3) Transmit.

NOTE

When selecting the desired radio for communications with the transmitter selector, transmission capability only is achieved. To receive, the associated audio panel select switch must be ON.

1. Transmitter Select – As desired (**HF, UHF,** or **VHF**).

2. **MIC NORMAL / OXYGEN MASK** Switch (instrument panel) – As desired.

3. **MIC** Switch – Press to transmit.

(4) Intercommunication.

1. Both **AUDIO SPKR** Switches – **OFF**.

2. **EMER / NORM AUDIO** Switch – **NORMAL**. Interphone communications are inhibited in **EMER** position.

3. **MIC NORMAL / OXYGEN MASK** Switch (instrument panel) – As desired.

4. **INTPH HOT / OFF** Select Switch – As desired.

   a. **INTPH HOT** – Talk when ready.

   b. **INTPH** – Rotate transmitter selector to **INTPH**, press **MIC** switch, and transmit.

5. **VOL** Knob (center of transmitter selector) – Adjust.

(5) Aircraft to Ground Intercom. A communications jack on the nose gear strut, placarded **MIC JACK**, is provided for use between the ground personnel and the pilot. The jack connects headphones and microphone to the aircraft interphone system but is limited to use between the ground personnel and the pilot position only. When in use, the aircraft to ground system will inhibit inter-communications between the pilot and copilot regardless of the transmitter select or interphone switches position. The aircraft to ground interphone system receives electrical power through, and is protected by, the circuit breaker placarded **NAV MEMORY** located on the hot battery bus.

(6) Cabin Intercom Operation. Rotate transmitter selector to **CABIN** and press **MIC** switch to talk.

(7) Emergency Audio Operation. Fail-safe emergency audio is available. If either amplifier for the dual audio panel should fail, non-amplified signals will be directed to the headphones.

NOTE

An alternate method of activating emergency audio is to pull both the pilot and copilot audio circuit breakers.

1. **EMER / NORM** Audio Switch – **EMER**. Both systems are now in emergency audio.

2. **VOL** Controls (systems to be monitored) – Adjust.

(8) Shutdown.

1. **AVIONICS MASTER POWER** Switch (pedestal) – **OFF**.

2. Avionics Controls and Circuit Breakers – Positioned for normal operation.

3. Aircraft dc Power – **OFF**.

3C-7. VHF COMMUNICATIONS TRANSCEIVER CTL-22.

Refer to Chapter 3, Paragraph 3-4 for detailed information.

3C-8. ULTRA-HIGH FREQUENCY.

a. Description. The UHF (ARC-164) is a line of sight radio transceiver which provides transmission and reception of Amplitude Modulated (AM) signals in the ultra high frequency range of 225.000 to 399.975 MHz for a distance range of approximately 50 miles. Channel selection is spaced at 0.025 MHz. Audio signals are applied through the pilot's and copilot's **UHF AUDIO** switches to the respective headsets. A separate receiver is incorporated to provide monitoring capability for the UHF guard frequency (243.0 MHz).

b. UHF Controls and Functions. Refer to Figure 3C-2.

(1) Manual Frequency Selector (Hundreds) – Selects hundreds digit of frequency (either 2 or 3) in MHz.

(2) Manual Frequency Selector (Tens) – Selects tens digit of frequency (0 through 9) in MHz.

(3) Manual Frequency Selector (Units) – Selects units digit for frequency (0 through 9) in MHz.

(4) Preset Channel Indicator – Displays preset channel selected.

(5) Manual Frequency Selector (Tenths) – Selects tenths digit of frequency (0 through 9) in MHz.

(6) Preset Channel Selector – Selects 1 of 20 preset channel frequencies.

(7) Manual Frequency Selector (Hundredths Or Thousandths) – Selects hundredths or thousandths digits of frequency (00, 25, 50, or 75) in MHz.

(8) Mode Selector – Selects method of frequency selection.

NOTE

The GUARD position should not be used except in actual emergencies. When operating under emergency conditions, set the MANUAL / PRESET / GUARD switch to the GUARD position and the function switch to MAIN. Do not use the BOTH position since noise from the two receivers may make the incoming signal unreadable.

(a) ***MANUA*****L** – Any one of 7,000 frequencies can be manually selected using the five manual selectors.

(b) ***PRESET*** – Frequency is selected using the preset channel selector to select any one of 20 preset channels.

(c) ***GUARD*** – The main receiver and transmitter are automatically tuned to the guard frequency and the guard receiver is disabled.

(9) ***SQUELCH*** *Switch* – Turns main receiver squelch circuit on or off.

(10) Volume Control – Adjusts volume.

(11) ***TONE*** *Push Button* - When pressed, transmits a 1020 Hz tone on the selected frequency.

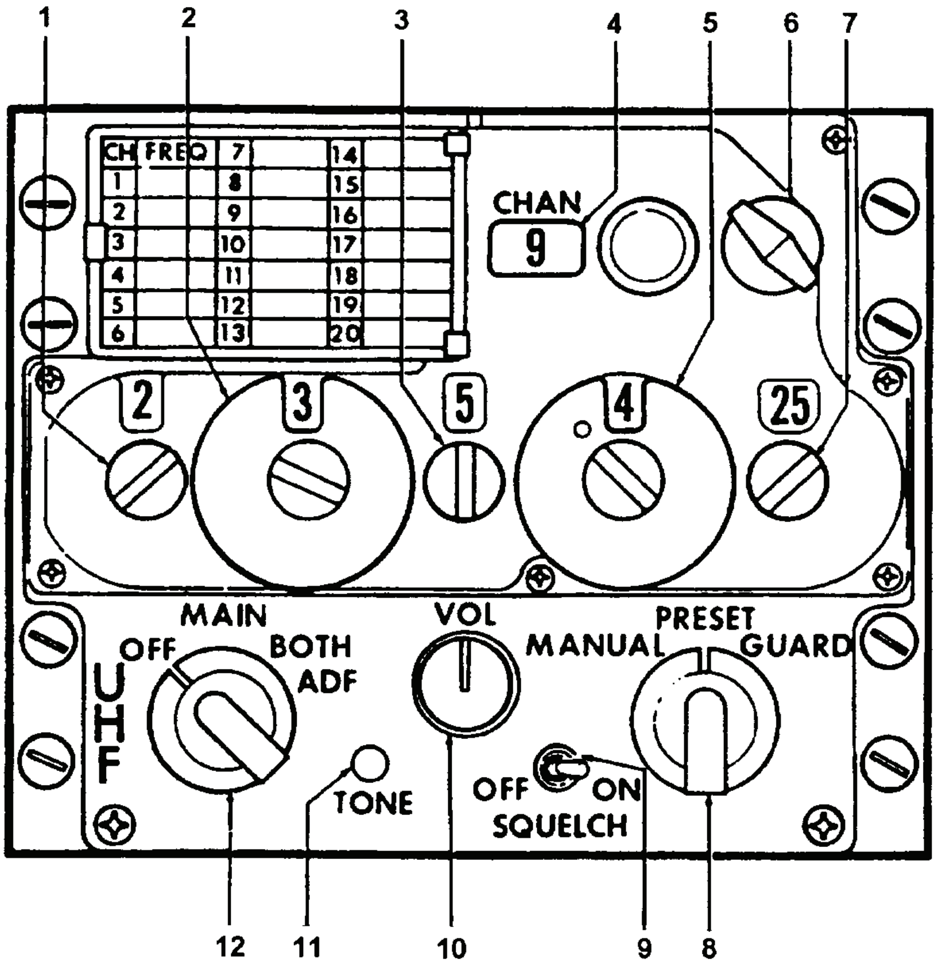
(12) Function Switch – Selects operating functions.

(a) ***OFF*** – Turns set off.

(b) ***MAIN*** – Turns set on.

(c) ***BOTH*** – Selects main receiver, transmitter and guard receiver.

(d) ***ADF*** – Not used in this installation.



1. Manual Frequency (100 MHz) Selector Indicator
2. Manual Frequency (10 MHz) Selector Indicator
3. Manual Frequency (1 MHz) Selector Indicator
4. CHAN Indicator
5. Manual Frequency (kHz) Selector Indicator
6. PRESET Chan Selector
7. Manual Frequency (10 kHz and 1 kHz) Selector Indicator
8. Mode Selector
9. SQUELCH Switch
10. VOL Control
11. TONE Push button
12. Function Switch

Figure 3C-2. UHF Control Panel

3C-9. HF COMMUNICATION SET (KHF-950).

Refer to Chapter 3, Paragraph 3-3 for detailed information.

3C-10. EMERGENCY LOCATOR TRANSMITTER.

a. Description. An automatic or manually activated Emergency Locator Transmitter (ELT) is located in the right side of the fuselage at approximately FS 340.00. The associated antenna is mounted on top of the aft fuselage at approximately the same location. An access hole, with spring-loaded cover, is located in the fuselage skin adjacent to the transmitter, enabling a downed pilot to manually initiate or terminate operation or reset the ELT to an armed mode. The transmitter contains an impact G switch that automatically activates the transmitter following a 3G to 7 G impact along the flight axis of the aircraft. When activated, the ELT will radiate omnidirectonal RF signals on the international distress frequencies of 121.5 MHz and 243.0 MHz. The radiated signal is modulated with an audio swept tone.

Internal batteries provide transmitter operation for a minimum of 48 hours.

b. Switches and Functions.

(1) ***ARM*** – Establishes readiness state to start automatic emergency signal transmissions, when the force of impact exceeds a preset threshold.

(2) ***ON*** – Turns set on initiating emergency signal transmissions.

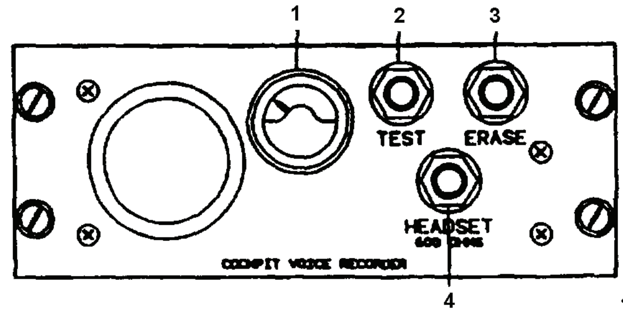
(3) ***OFF*** – Turns set off.

3C-11. COCKPIT VOICE RECORDER SYSTEM OSA .

a. Introduction. The Cockpit Voice Recorder (CVR) system records all voice signals on a continuous loop magnetic tape for a maximum period of 30 minutes. Voice recordings in excess of 30 minutes are automatically erased. The voice inputs may be either transmitted or received signals originating from the aircraft's communications system or the remotely mounted cockpit area microphone mounted in the glareshield. The CVR system is a modular system comprised of three modules, the recorder, the control unit and a remote microphone. The recorder is a vibrator mounted unit housed in an international orange case located in the unpressurized aft fuselage area. The recorder contains the recording unit and associated electronics. An impact switch, mounted in the aft avionics compartment, controls power to the voice recorder. If the impact switch is subjected to a 2.5 G shock, the recorder is electrically disconnected to prevent further recording and erasure of voice communications. A red light located on the impact switch case, when illuminated, indicates the switch has been actuated. Pressing the reset button, located adjacent to the impact switch light, causes the light to extinguish and restores power to the voice recorder. The control unit is located on the extended pedestal and houses the microphone preamplifier, test switch, erase switch, and a meter. The remote microphone module is located in the glareshield outboard of the warning annunciator panel. The CVR system receives 115 Vac power through a 1-ampere circuit breaker, placarded **RECORDER POWER – VOICE**, located on the copilot's sidewall circuit breaker panel.

b. Controls, Indicators, and Functions. Refer to Figure 3C-3.

(1) Go/No-Go Self-Test Meter – Provides visual indication of Go/No-Go during preflight self-test.



1. **Meter**
2. **TEST Switch**
3. **ERASE Switch**
4. **HEADSET Jack**

Figure 3C-3. Cockpit Voice Recorder Control Unit OSA

(2) ***TEST*** *Switch* – Allows testing of recording mode. Meter indicates self-test Go/No-Go indication and an aural tone is produced through headset jack.

(3) ***ERASE*** *Switch* – Permits erasure of recording at end of flight. To prevent accidental erasure, the switch must be held for 2 seconds with the landing gear extended and the weight of the aircraft on the landing gear and the parking brake set.

(4) ***HEADSET*** *Jack* – Allows monitoring of voice recordings, after a 2-second delay and an aural tone during self-test.

3C-12. FLIGHT DATA RECORDER OSA.

a. The digital flight data recorder system (referred to herein as a crash data recorder) continuously records flight data inputs for the last 25 hours of flight. The flight data parameters recorded are heading, altitude, vertical acceleration, and airspeed. The data is recorded on a continuous loop, 1/4 inch, self-lubricating magnetic tape bundle. The tape is drawn out of the hub and returned to the supply reel at the outer periphery of the bundle after having passed the write and read heads. The tape capsule is protected by an inner aluminum casing, an isothermal shield, outer stainless steel casing, and an outside steel dust cover. The construction of the cases provides survivability assurance while the isothermal shield provides protection from temperatures. There are no pilot accessible controls or switches associated with recorder. Its operation is completely automatic. An impact switch, mounted in the aft avionics compartment, controls power to the recorder. If the impact switch is subjected to a 2.5 G shock, the recorder is electrically disconnected to prevent further recording and erasure. A red light located on the impact switch case, when illuminated, indicates the switch has been actuated. Pressing the reset button located adjacent to the impact switch light causes the light to extinguish and restores power to the recorder.

b. The recorder system is powered through a 1-ampere 115 Vac circuit breaker, placarded **RECORDER POWER** – **FLT**, located on the copilot's sidewall circuit breaker panel.

c. A battery powered, acoustic underwater locator beacon assembly is mounted on the front panel of the crash data recorder. The unit consists of a self-contained battery, an electronic module and a transducer. The battery is shock mounted and is separated from electronic module by a bulkhead in the case. The beacon (pinger) radiates a pulsed acoustic signal into the surrounding water upon activation of its water-sensitive switch and will activate automatically on submersion in salt or fresh water with an operating life expectancy of 30 days to a depth of 20,000 feet.

Section III. NAVIGATION

3C-13. ATTITUDE AND HEADING REFERENCE SYSTEM.

a. Vertical Gyro System. The pilot's and copilot's vertical gyro systems are independent and powered by the ac power bus located in the nose avionics compartment. The purpose of the vertical gyro systems is to provide the pilots with visual indications of aircraft pitch and roll attitudes on the flight director indicators. The gyroscope develops through synchros, pitch, and roll signals representative of the aircraft attitude. Vertical reference is established by two gravity sensitive switches that control a torque motor for each gyro axis. High or low erection rate of the gyro is accomplished by applying high or low voltage to the respective torque motor. Panel mounted switches, placarded **NO. 1** (pilot) and **NO. 2** (copilot) **V GYRO FAST ERECT**, provide the means for fast erection of the gyros. Pressing the **FAST ERECT** switch will erect the gyro to within 1.0° of pitch and roll within 60 seconds of power application, and erect to within 0.5° within 2 minutes.

b. Gyro Magnetic Compass System. Two identical compass systems provide accurate directional information for the aircraft at all latitudes of the earth. For heading reference, two modes of operation are used: directional gyro (FREE) mode, or slaved (SLAVE) mode.

(1) In areas where magnetic references are reliable, the system is operated in the SLAVE mode. In this mode, the directional gyro is slaved to the magnetic flux valve that supplies magnetic reference for correction of the apparent drift of the gyro. In FREE mode, the system is operated as a free gyro. In this mode, latitude corrections are manually introduced using the **INCREASE / DECREASE** switches located outboard of each HSI. The SLAVE/FREE mode is selected as desired using the **SLAVE / FREE** switches also located outboard of each HSI. Both compass systems (No. 1 and No. 2) are ac power dependent and are powered by the selected inverter.

(2) Gyro compass 1 provides heading information for the pilot's HSI and copilot's RMI. Gyro compass 2 serves the copilot's HSI and the pilot's RMI.

c. Comparator Monitor OSA. The comparator monitor is a self-contained, five-channel, six-light instrumentation comparator used to monitor and compare the pilot and copilot flight in instrumentation systems for similar pitch and roll attitude, heading, localizer signal, and glideslope signal. A pre-determined difference between the systems is indicated by illumination of the applicable annunciator (**ROLL, PITCH, HDG GS**, or **LOC**). The comparator has a self-monitoring feature that checks the internal electronics of the comparator and displays any internal failure on an individual (**MNTR**) annunciator. All six annunciators are located above the pilot's altimeter and are tested along with the other aircraft annunciator lights by pressing the **PUSH-TO-TEST** switch located on the warning annunciators panel. An illuminated comparator annunciator may be extinguished by pressing the light face or, should a fault correct itself, the light will extinguish automatically.

*(1) Attitude Monitor (**ROLL, PITCH**).* Two separate channels of roll and pitch attitude monitoring are provided. Each attitude channel receives input signals from a differential resolver synchro located in the attitude director indicator. An angular difference of 6° in roll or pitch will result in a fault indication.

*(2) Compass Monitor (**HDG**).* The compass monitor receives input from synchros in the HSI's. A nominal heading difference in unbanked flight of 6° will result in a fault indication.

*(3) Localizer Deviation (**LOC**).* The localizer deviation signals are received from both VHF NAV receivers. The nominal fault indication difference is approximately 1/2 dot.

*(4) Glideslope (**GS**).* The glideslope deviation signals are received from both glideslope

receivers. Approximately 1/2 dot difference will result in a fault indication.

*(5) Self-Test (**MNTR**).* Checks the monitor 26 Vac and 28 Vdc supply for a pre-determined voltage. The annunciator is illuminated when either voltage falls below this preset level.

3C-14. ATTITUDE DIRECTOR INDICATOR.

a. Description. The Attitude Director Indicator (ADI) combines the attitude sphere display with computed steering information to provide the pilot commands required to intercept and maintain a desired flight path. It also contains an eyelid display, expanded localizer, glideslope, rising radio altitude bar and inclinometer. The indicator has go-around and decision height annunciators. Any warning flag in view indicates the respective (**ATT**, **GS** or **FD**) information is unreliable. Refer to Figure 3C-4.

(1) Go-Around Annunciator – Illuminates when the go-around mode has been selected.

(2) Flight Director Warning Flag – When in view, it indicates flight director information is unreliable.

(3) Bank Angle Scale – The bank angle scale has reference marks at 0, 10, 20, 30, 45, 60, and 90 degrees to indicate angle of bank.

(4) Bank Angle Pointer – The bank angle pointer displays actual roll attitude through a movable pointer that points to the angle on the Bank Angle Scale.

(5) Attitude Warning Flag – When in view, this warning flag indicates that attitude information is unreliable.

(6) Decision Height Annunciator – Illuminates when aircraft descends below selected decision height as set on the radio altimeter indicator.

(7) Glideslope Scale – Displays aircraft deviation from glideslope beam center only when tuned to ILS frequency and a valid glideslope signal is present. The glideslope dot represents approximately 0.4° deviation from the beam centerline.

(8) Glideslope Pointer – Indicates aircraft is below glide path if pointer is displaced upward and above glide path if pointer is displaced downward.

(9) Symbolic Miniature Aircraft – Serves as a stationary symbol of the aircraft. Aircraft pitch and roll attitudes are displayed by the relationship between the fixed miniature aircraft and the movable sphere. The symbolic aircraft is flown to, and aligned with, the command cue to satisfy the commands of the flight director mode selected.

(10) Radar Altitude Display Bar (Rising Runway) – For added backup during the critical approach phase of flight, absolute altitude above the terrain is displayed below 200 feet by a barber-pole radio altitude bar. The bar appears at 200 feet and moves toward the miniature aircraft as the aircraft descends toward the runway, contacting the bottom of the symbolic aircraft at touchdown.

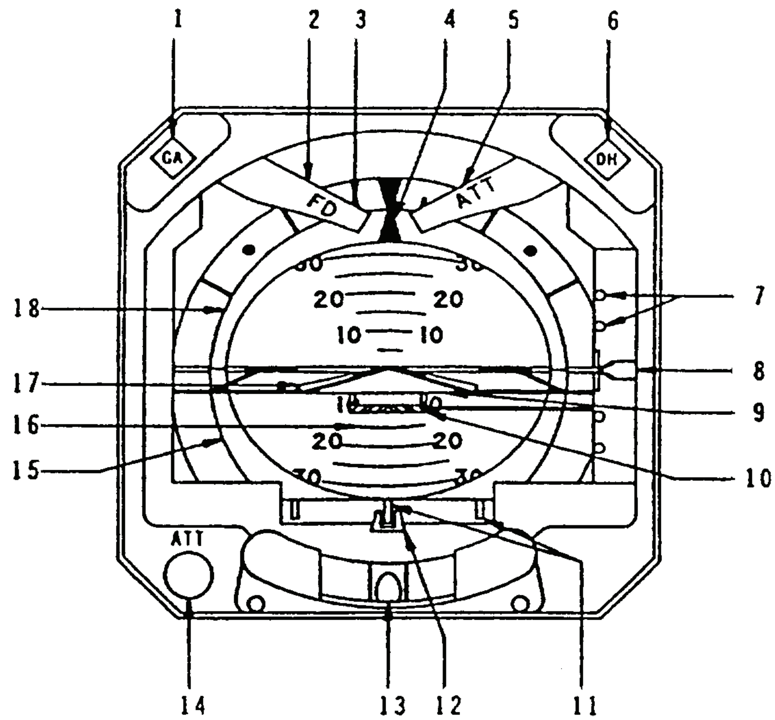
(11) Expanded Localizer Scale – A scale whose width equals 1/2° of the localizer beam signal. The position of the localizer indicator indicates the aircraft’s position with respect to the center of the localizer.

(12) Expanded Localizer Indicator – Raw localizer displacement data from the navigation receiver (HSI display) is amplified approximately 7–1/2 times to permit the expanded localizer pointer to be used as a sensitive reference indicator of the aircraft's position with respect to the center of the localizer. It is normally used for assessment only, since the pointer is very sensitive and difficult to fly throughout the entire approach. During final approach, the pointer serves as an indicator of the Category II window.

(13) Inclinometer – Gives the pilot a conventional display of aircraft slip or skid and is used as an aid to coordinated maneuvers.

(14) Attitude Test Switch – Operates the attitude self-test. When pressed, the sphere will show approximately a 20° right bank and a 10° pitch-up attitude and the **ATT** warning flag will display.

(15) Lower (Brown) Eyelid Display – Always shows the relative position of the ground. Surrounds bottom half of the attitude sphere and provides positive attitude identification. The eyelids maintain the proper ground-sky relationship, regardless of the position of the sphere, facilitating fast recover from unusual attitudes.



1. **Go-Around Annunciator**
2. **Flight Director Warning Flag**
3. **Bank Angle Scale**
4. **Bank Angle Pointer**
5. **Attitude Warning Flag**
6. **Decision Height Annunciator**
7. **Glideslope Scale**
8. **Glideslope Pointer**
9. **Symbolic Miniature Aircraft**
10. **Radar Altitude Display Bar (Rising Runway)**
11. **Expanded Localizer Scale**
12. **Expanded Localizer Indicator**
13. **Inclinometer**
14. **Attitude Test Switch**
15. **Lower (Brown) Eyelid Display**
16. **Pitch Angle Scale**
17. **Flight Director Command Cue**
18. **Upper (Blue) Eyelid Display**

Figure 3C-4. Attitude Director Indicator

(16) Pitch Angle Scale – Moves with respect to the symbolic aircraft reference to display actual pitch and roll attitude. Pitch attitude marks are in 5° increments on a blue and brown sphere. These colors are the most contrasting and acceptable display colors from a human factor standpoint.

(17) Flight Director Command Cue – The three-dimensional command cue displays the computed steering commands to intercept and maintain a desired flight path. The cue moves up or down to present pitch commands and rotates clockwise or counterclockwise for roll commands.

(18) Upper (Blue) Eyelid Display – Always shows the relative position of the sky. Surrounds upper half of the attitude sphere and provides positive attitude identification by means of a blue eyelid, which always shows the relative position of the sky, and a brown eyelid, which always shows the relative position of the ground. The eyelids maintain the proper ground-sky relationship, regardless of the position of the sphere. This facilitates fast recovery from unusual attitudes.

3C-15. STANDBY ATTITUDE REFERENCE SYSTEM.

a. Description.

(1) **OSA** . The standby attitude reference system, comprised of the attitude indicator located on the extreme left center of the pilot's instrument panel and a 28 Vdc emergency power supply, provide a visual indication of the aircraft flight attitude. The attitude reference system is designed to provide a standby attitude indicator that is powered by a source independent of the aircraft electrical generating system. The system will provide reliable attitude

information for at least 30 minutes after a total failure of the aircraft electrical system.

The power supply contains sealed lead-acid batteries with a rating of 5.0 ampere hours. During normal operation, the aircraft 28 Vdc system supplies power to the indicator and power supply batteries. In the event aircraft electrical power fails, the power supply will take over the duties of powering the attitude indicator.

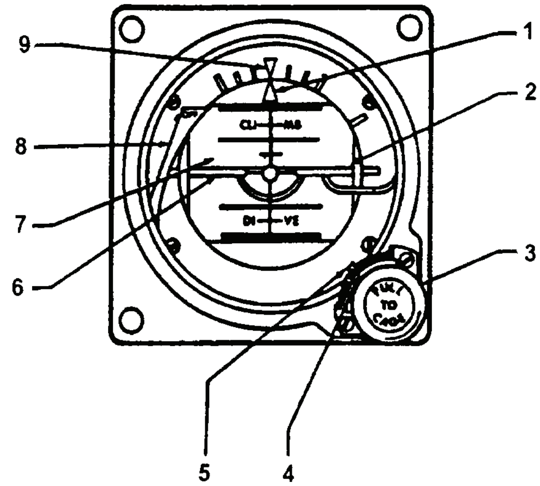
The attitude indicator is a 28 Vdc powered, electrically driven gyro and contains an inverter circuit board for converting the 28 Vdc input to 22 Vac 400 Hz for indicator operation. The power warning flag is rotated out of sight by a flag motor that allows the flag to display if one or more phases of power are interrupted. The flag motor also allows the flag to display if the **PULL TO CAGE** knob is in the caged position. The rotor speed and the mechanical erection system enable the indicator to provide a minimum of 9 minutes of useful attitude information after complete electrical power interruption.

(2) **ANG** . The standby attitude indicator, located on the extreme left center of the pilot's instrument panel, is powered by engine bleed air and provides a visual reference of the aircraft pitch and roll. The attitude indicator is comprised of a self contained gyro to erect the sphere which provides the pitch and roll reference, an indicating symbol which represents the aircraft, and a horizontal line behind the indicating symbol which represents the horizon. The moveable indicating symbol may be adjusted vertically to correct for variations in level flight attitudes by a small knob located on the front base of the indicator.

b. Controls, Indicators, and Functions.

(1) A three-position switch and a three-legend annunciator unit, located below the indicator, provide system control, test, and visual indication of the system status. The three-position switch (normally **OFF**), placarded **ON / OFF / TEST**, provides control and test capabilities of the battery powered system. While in the normal **OFF** position, the annunciator placarded, **AUX ARM**, will be illuminated indicating the system batteries are being maintained in a charged condition and the system is in a standby (non-active) mode. Placing in the **TEST** position activates a check of the battery pack and illuminates the **AUX TEST** annunciator. Placing in the **ON** position activates the Standby Horizon Indicator system and illuminates the **AUX ON** annunciator (provided the system circuit breaker is set).

(2) Standby Attitude Reference Indicator Functions **OSA** *.* Refer to Figure 3C-5.



1. **Roll Pointer**
2. **Horizon Line**
3. **Caging/Pitch-Trim Knob**
4. **Trim Pointer**
5. **Pitch-Trim Scale**
6. **Miniature Aircraft**
7. **Drum**
8. **Power Warning Flag**
9. **Roll Index**

***Figure 3C-5. Standby Attitude Reference Indicator* OSA**

(a) Roll Pointer – Indicates vertical in any roll attitude.

(b) Horizon Line – Indicates earth's horizon relative to aircraft pitch attitude.

(c) Caging / Pitch-Trim Knob – Pulled to cage the indicator and rotated to adjust the miniature aircraft attitude.

(d) Trim Pointer – Indicates trim displacement.

(e) Pitch-Trim Scale – Measures displacement of miniature aircraft.

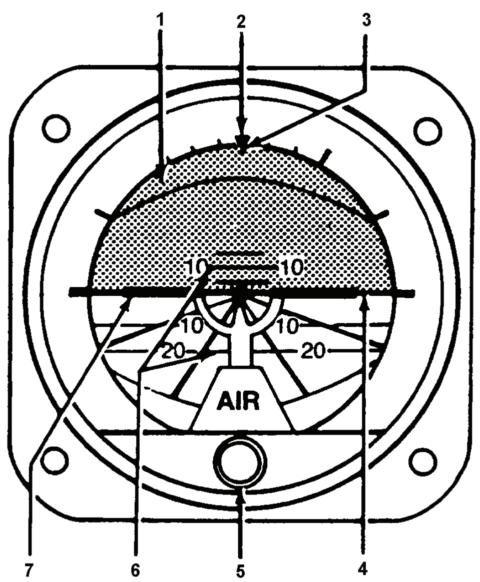
(f) Miniature Aircraft – Represents aircraft nose and wings. Indicates roll and pitch attitude relative to the horizon. Adjustable through pitch trim knob for varying pitch attitudes.

(g) Drum – Directly linked to the spin motor to provide direct reading of aircraft movement in roll and pitch. Marked each 5° in pitch. Black area of drum indicates dive and blue or gray area indicates climb.

(h) Power Warning Flag – In view, indicates power off, caged condition, open motor winding, or loss of power. Retracted, indicates normal operation.

(i) Roll Index – Rotates with aircraft to provide measurement of angular displacement by the roll pointer during maneuvers.

(3) Standby Attitude Indicator Functions **ANG**. Refer to Figure 3C-6.



1. **Attitude Sphere**
2. **Roll Index**
3. **Roll Pointer**
4. **Horizon Line**
5. **Pitch Knob**
6. **Pitch Scale**
7. **Symbolic Miniature Aircraft**

Figure 3C-6. Standby Attitude Indicator **ANG**

(a) Attitude Sphere – Moves with respect to the symbolic miniature aircraft reference to display pitch and roll attitude.

(b) Roll Index – Rotates with aircraft to provide measurement of angular displacement by the roll pointer.

(c) Roll Pointer – Indicates vertical in any roll attitude.

(d) Horizon Line – Indicates earth's horizon relative to aircraft pitch attitude.

(e) Pitch Knob – Rotated to adjust the miniature aircraft.

(f) Pitch Scale – Measures pitch displacement of miniature aircraft.

(g) Miniature Aircraft – Represents aircraft nose and wings. Indicates roll and pitch attitude relative to the horizon. Adjustable through pitch knob for varying pitch attitudes.

3C-16. DATA NAV SYSTEM.

a. Introduction. The Data NAV equipment enables the operator to use the color weather radar indicator to display radar returns, checklists, or navigation symbology/alpha-numeric. The navigation data is derived from external VOR/DME, or TACAN devices as selected by the two HSI source push switches located outboard of each HSI. Refer to Figure 3C-7.

The four principal display modes in which the radar indicator operates are Radar Returns (WXD), Navigation (NAV), Checklists, and Auxiliary.

b. Data NAV Switches and Controls.

(1) ***OFF / NORM INDEX / NORM LIST / WXD / EMER INDEX / EMER LIST / NAV / AUX***. Rotary switch used to turn Data NAV Interface Computer off or on by selection of checklist, weather (WXD), navigation (either NAV or with weather), or Auxiliary operation.

(2) ***NAV 1*** – The pilot's navigation information is displayed via the latching push-button switch, **NAV 1** (green).

(3) ***DES IN / DES OUT*** – Momentary left-right 3-position switch used to move the designator along radial established by **RAD** control.

(4) ***NAV 2*** – Latching push-button switch used to select **NAV 2** station (yellow).

(5) ***CS 1*** – Latching push-button switch used to select course line (green) and readout for **NAV 1** station.

(6) ***CS 2*** – Latching push-button switch used to select course line (yellow) and readout for **NAV 2** station.

(7) ***DES NAV 1 / DES NAV 2***. Slide-switch used to select designator for **NAV 1** or **NAV 2** station.

(8) ***HDG*** – Latching push-button switch used to select a line (white) display.

(9) ***HOME*** – Momentary push-button switch used to position designator on **VOR** symbol, with tick pointing to magnetic north.

(10) ***RCL*** – Momentary push-button switch used to recall the first item skipped during checklist operation. Not enabled in **INDEX**es.

(11) ***SKIP*** – Momentary push-button switch used to Skip and not check any item during checklist operation. Not enabled in **INDEX**es.

(12) ***LINE*** – Momentary push-button switch used to advance from one line to next during checklist operation.

(13) ***PAGE*** – Momentary push-button switch used to advance from one page to the next during checklist operation.

(14) ***RAD*** – Left-right (CCW-CW) action switch used to radially rotate designator about VOR display.

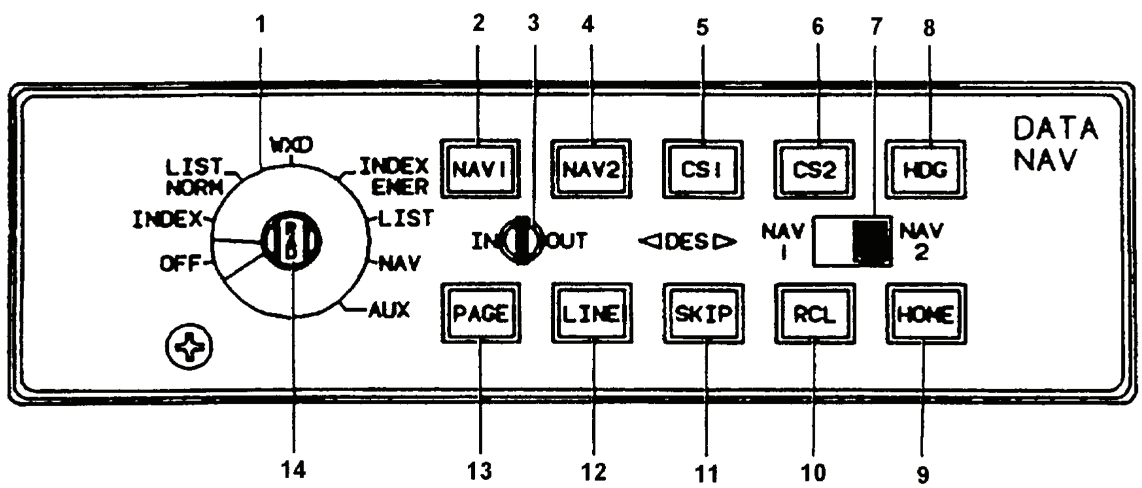
c. Display Modes.

*(1) Radar Returns (**WXD**).* Setting the control unit rotary switch to **WXD** disconnects the interface computer from the indicator and allows the display of normal radar returns.

The system can be turned on or off independently of an operating radar. Selection of the radar (WXD) mode at the control unit is a default selection (i.e., it disconnects the system from the radar system so that the radar can operate in normal fashion).

The system supplies no indication to an auxiliary device that it has been selected or rejected. With certain exceptions, the auxiliary equipment operates only in response to its own controls, whether or not its outputs are displayed. Except for the display, the radar operates in whatever mode has been selected for it on the indicator control panel, regardless of switch selection on the control unit. Only the display is affected by control unit switches; however, the radar will override a system input if the target-alert mode is active and a target enters the target-alert sector. When the target-alert sector clears, the radar Indicator resumes the display selected at the control unit.

(2) Navigation. The navigation function allows the operator to display radar returns Superimposed with navigational symbols and navigational data from external sources.



1. Rotary Selector Switch
2. NAV 1
3. DES IN – DES OUT
4. NAV 2
5. CS 1
6. CS 2
7. DES NAV 1 – DES NAV 2
8. HDG
9. HOME
10. RCL
11. SKIP
12. LINE
13. PAGE
14. RAD

Figure 3C-7. Data NAV Control

(a) Navigation Displays. The navigation displays are selected by placing the rotary switch on the control unit to NAV. In this mode, Data NAV enables data from two independent navigation sources, if available, and displays either or both on the indicator. Additionally, the HSI's OBS knobs can be used to control a course line about the VOR when selected from the control unit.

The current magnetic heading of the aircraft is displayed on a scale at the top of the screen to establish a visual reference point for pilot orientation. Selected heading can also be displayed graphically on the indicator when HDG is activated on the control unit.

When the appropriate designator is selected, via the control unit, the active VOR establishes a reference point for the designator. The designator controls on the control unit will then move the designator symbol to any point on or off the screen within approximately 423 nm of the VOR and display the radial and distance to the designator from the VOR. A solid line connects the designator position to the VOR. The homed designator position is the VOR.

The designator can be selected to work with the VOR for either of the navigation sources via the **NAV 1 / NAV 2** slide-switch on the control unit. Alphanumeric readout of radial and distance of the designator from the VOR, as well as bearing (magnetic) and distance to the designator from the aircraft, is displayed on the screen.

The designator can be used to create a waypoint on the display from a VOR or TACAN. Since the designator is fixed geographically relative to VOR, it can be used similar to a waypoint, although not coupled to GDI.

When the **HOME** button is pressed, the designator is returned to the VOR and the readout of distance to designator and radial of designator with respect to VOR goes to zero.

When the designator is activated for one VOR and then the other VOR selected, the system will retain the data for the first navigation source in memory. An asterisk in the color of the first navigation source will be displayed in the top left hand of the screen to the right of the Station-to-Designator (S-D) legend, provided that data on the position of the first navigation source is present. This asterisk will be removed when position data is lost.

(b) Graphic Displays. The graphic display symbols are Superimposed on displays of radar returns. Refer to Figure 3C-8.

Figure 3C-8. Graphic Display Symbols

1 *Ground Station* Symbol. The VORTAC or VOR/DME symbol is accompanied by a readout of the station radial and ID, displayed in the lower left portion of the display.

2 *DESIGNATOR SYMBO***L**. The DESIGNATOR SYMBOL is selected to work with the VOR for either station by the control unit.

3 *Compass Heading.* The current magnetic heading of the aircraft is displayed on a scale at the top center of the screen. A selected heading line may also be displayed by pressing the **HDG** switch on the Control Unit.

4 *Course Lines.* The waypoint and ground station symbol course lines are displayed as solid lines through the symbols and originate from a position determined by the settings of the HSI(s) **OBS** knobs.

5 ***DES NAV 1 / DES NAV 2*** *Slide Switch.* The designator **IN / OUT** and **RAD** controls are used to move the designator symbol to any point on or off the screen, with the VOR as reference, and display radial and distance to the designator from the VOR, whether or not the VOR station is within radar range, as long as signals are being received. The S-D readout is displayed in the upper left portion of the display and the Aircraft-to-Designator (A-D) readout is displayed in the lower right portion of the display. With the designator in the home position, or positioned on the VOR, a tick is displayed to indicate the direction of OUT movement. This tick is removed once the designator is moved out from the ground station symbol. A solid line connects the designator symbol to the VOR symbol. By pressing the **HOME** switch, the designator is positioned on the VOR, with the tick pointing to magnetic north.

(3) NAV Operation.

WARNING

To prevent electromagnetic radiation in ramp, terminal, taxiway, or other areas occupied by personnel, operate radar only in STANDBY mode.

CAUTION

Do not operate radar system, even in STANDBY mode, without 115-Vac, 400-Hz power applied to the system. Without ac power, the receiver/transmitter/cooling blower will not operate, which could result in circuit damage and/or automatic shutdown.

The following paragraphs provide the procedures utilizing the capabilities of the NAV function. These paragraphs are presented in sequential order from initialization to a composite navigation display.

For the purpose of explanation, only NAV 1 controls and symbols are addressed in the following procedures, except for the composite selection.

(a) *Initial Entry*.

1. Turn on radar set and external navigation equipment (i.e., compass, DME, radio, etc.).

2. Set rotary switch to NAV and observe that disclaimer notice displays and remains until any NAV switch is changed.

3. With no selections made on the control unit, the only display is the magnetic heading readout. If, for some reason, the compass is inoperative, the three digits are replaced with dashes.

(b) ***NAV 1/DES NAV*** *Selection*.

1. Tune in desired VOR stations to be used as **NAV 1** and **NAV 2**.

2. Place **DES NAV 1 / NAV 2** switch to **NAV 1**.

3. Press **NAV 1** push button and note that green VOR symbol, distance, bearing, and station ID readouts display. If **DES NAV 1 / NAV 2** switch is placed to **NAV 2**, the VOR symbol remains, but designator readouts disappear.

NOTE

This assumes that the station is located in the area shown on the display. The ID readout will not appear until acquired by the DME receiver, this may take up to 2 minutes.

(c) ***NAV 1 / HDG*** *Selection*.

1. Press **HDG** push button and note that heading line (white) is displayed.

2. The selected heading line may now be moved by rotating the **HDG** knob on the HSI.

CAUTION

The operator must compare the heading error line display to the HSI heading bug to ensure that the display is in the correct quadrant. The display is correct only for heading errors less than 60º.

(d) ***NAV 1 / CS 1*** *Selection*. Press the **CS 1** push button and note that a green course line through the NAV 1 station symbol has been added to the display of the preceding paragraph. Note that the green CRS, bearing, and station ID appear in the lower left corner of the display.

(e) ***NAV 1 / DES*** *Selection*.

1. Rotate **RAD** control to position designator symbol to desired radial.

2. Hold **DES IN / OUT** switch in **OUT** position to move designator symbol to desired position.

3. Note that designator and connecting line are displayed from the station symbol, and that S-D data and A-D data appear in the upper left and lower right corners, respectively, of the display.

4. The designator may be homed to the selected NAV station symbol by pressing **HOME** push button; note that when pressed, the S-D readout is now all zeros.

(f) Composite Selection. Verify that two external stations have been selected.

1. Press **NAV 2** and **CS 2** push buttons.

2. Place **DES NAV 1 / NAV 2** switch to **NAV 2** position.

3. Move **DES IN / OUT** and **RAD** controls to present a display.

(g) DME Hold Display. The pilot may manually place the DME in a hold condition, in which case the S-D/A-D readouts and VOR and designator symbols disappear and the WPT CRS bearing numerals change to DMEH.

(4) Checklist. The rotary switch on the Control Unit has four checklist positions, **INDEX** and **LIST** positions for both emergency (**EMER)** and normal (**NORM)** operations. With the switch in either **INDEX** position, the indicator displays the appropriate index of procedures contained in the memories. The **PAGE** and **LINE** advance, **SKIP** and **RCL** momentary push-button switches are used in conjunction with the checklist displays. The **PAGE** switch allows the operator to advance from one page to the next in an index or list. The **LINE** switch allows the operator to advance from one procedure to another in an index, or from one item to another in a list. The **SKIP** switch allows the operator to bypass, or not check, any item in a list. The recall (**RCL)** switch allows the operator to return to the first page and item not checked, or skipped, remains. The following terms define the elements of the checklist displays.

(a) Checklist. A checklist is a collection of sequential procedures to be followed by a pilot. There are two checklists: one for normal procedures and one for emergency procedures.

(b) Procedure. A procedure consists of one or more related items that are checked in sequence by the pilot.

(c) Item. An item is a specific action taken or condition checked by the pilot. An item may be displayed on one or more lines.

(d) Index. An index consists of a list of all procedures by title, with each title numbered sequentially. There are two indexes: one for normal procedures and one for emergency procedures.

(e) Cursor. The cursor consists of changing the color of a selected procedure or item being checked in a list. The cursor turns the letters yellow in the **NORM INDEX** or **NORM LIST** and red in the **EMER INDEX** or **EMER LIST**. Unselected procedures in an index or unchecked items in a list are green. Items already checked in a list are blue.

WARNING

To prevent electromagnetic radiation in ramp, terminal, taxiway, or other areas occupied by personnel, operate radar only in STANDBY Mode.

CAUTION

Do not operate radar system, even in STANDBY Mode, without 115-Vac, 400-Hz power applied to the system. Without ac power, the receiver-transmitter-cooling blower will not operate, which could result in circuit damage and/or automatic shutdown.

(5) Checklist Operation. After turning on the radar, use the following procedure to sequence through the checklists:

(6) Initial Entry. To review the list of procedures, set the rotary switch to **NORM INDEX** for normal procedures or to **EMER INDEX** for emergency procedures.

To go directly to the first procedure, set the rotary switch to **NORM LIST** or **EMER LIST**.

A disclaimer notice will be displayed. Press **PAGE** to clear the notice and display the first page of the selected index or procedure.

(7) Procedure Selection Through Normal or Emergency Indexes.

1. Set rotary switch to **NORM INDEX** / **EMER INDEX**. Press **PAGE** to clear disclaimer notice and to display first page of index. Note that the first item is displayed in yellow (red).

2. If that is the desired procedure, set rotary switch to **NORM LIST** / **EMER LIST** to display first page of selected procedure.

3. Set rotary switch to **NORM INDEX** / **EMER INDEX**. Press **PAGE** to clear disclaimer notice and to display first page of index. Note that the first item is displayed in yellow (red).

4. If that is the desired procedure, set rotary switch to **NORM LIST** / **EMER LIST** to display first page of selected procedure.

5. To select another procedure, press **LINE** until the title of desired procedure is displayed in yellow (red).

6. Set rotary switch to **NORM LIST / EMER LIST** to display first page of selected procedure.

7. In a multiple-page index, review the listed titles by pressing **PAGE** to display subsequent index pages. At the last page of the index, loop back to the first page by pressing **PAGE**.

(8) Item Sequencing Through Normal Procedures.

1. To check off an item, press **LINE**. Note that the yellow cursor moves to the next item and that the checked item is displayed in blue.

2. To skip an item, press **SKIP**. Note that the yellow cursor moves to the next item and that the skipped item remains displayed in green.

3. Successively press **LINE** or **SKIP** to sequence through all items of the procedure.

4. To return to an unchecked item, press **RCL**. The display will return to the first page containing an unchecked item, with that item displayed in yellow.

5. After checking off skipped items on that page, the display will automatically advance to the next page containing an unchecked item.

6. If the last item in a procedure and all previous items in the procedure have been checked, advance to the first item of the next procedure by pressing **LINE**.

7. If the last item in a procedure, but some previous items in the procedure have been skipped, pressing **LINE** will cause the cursor to return to the first unchecked item in the procedure (i.e., you may NOT advance to the next procedure until skipped items are checked off).

8. In a multiple-page procedure, to review the listed items, press **PAGE** to display subsequent pages. At the last page of the procedure, loop back to the first page by pressing **PAGE**.

NOTE

Block check is available only in NORM LIST mode; it is inhibited in EMER LIST mode.

In EMER LIST, the LINE button will NOT sequence to the next emergency procedure when the current emergency procedure is completed. To enter the next emergency procedure, set rotary switch to EMER INDEX and press LINE to move the cursor to the next procedure. Then set rotary switch to EMER LIST to display the first page of the next procedure.

(9) Block Check-off In Normal Procedures. The block check feature permits the checking off of many items simultaneously. This feature can be used as follows:

1. On the displayed page, position the yellow cursor to the first item of the block (using **LINE** or **SKIP**).

2. Press **PAGE** to advance to the next or subsequent page.

3. Press **LINE** and note that the cursor displays on the first unchecked item on the displayed page.

All items between the original cursor position, inclusive, and the current cursor position have been checked off. To verify, press **PAGE** a sufficient number of times to loop back to the original page and note that all items from the beginning of the block to the present cursor position, exclusive, are now displayed in blue.

(10) Item Sequencing Through Emergency Procedure.

1. To check off an item, press **LINE**. Note that the red cursor moves to the next item and that the checked item is displayed in blue.

2. To skip an item, press **SKIP**. Note that the red cursor moves to the next item and that the skipped item remains displayed in green.

3. To return to an unchecked item, press **RCL**. The display will return to the first page containing an unchecked item, with that item displayed in red.

4. When the last unchecked item in the emergency procedure is checked off and all previous items in the procedure have been checked and **LINE** is pressed, the word **COMPLETE** is printed in red in the center of the last available line on the last page of the procedure.

(11) Re-initialization. If the checklist display is not functioning properly, re-initialize the checklist operation as follows:

1. Set rotary switch to **OFF**.

2. Set rotary switch to any desired **INDEX** or **LIST** position.

3. Press **PAGE** push button to display first page of chosen index or list.

(12) Auxiliary. When the rotary switch on the control unit is set to **AUX**, the interface computer is available for inputs from the auxiliary equipment.

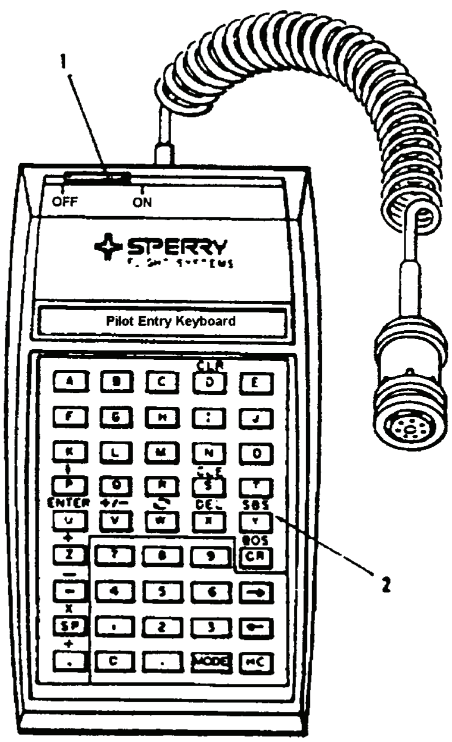
(13) Pilot Entry Keyboard. The operator may use a hand-held keyboard, Figure 3C-9, to enter data of his own into a section of the Data NAV system memories for display on the Indicator. Data entered by the pilot is stored in a memory that is not permanent in the same sense as those memories containing the airplane checklists. However, the non-permanent memory is kept alive by a 3.6-volt nickel-cadmium battery that recharges each time the Data NAV system is turned on. Depending upon the state of charge and the storage temperature, the battery could keep the pilot-entered data intact for as long as 6 months. The keyboard coil-cord is plugged directly into a bulkhead-type connector mounted for pilot convenience. The bulkhead connector, in turn, is wired by way of the aircraft wiring to the Data NAV system.

NOTE

At the top of the keyboard unit is the ON / OFF switch that controls a 5-volt input. Whenever the keyboard is being connected to, or disconnected from, the aircraft connector, this switch must be in the OFF position to prevent possible damage to integrated circuits inside the keyboard.

(a) Keyboard Controls. All controls used to operate the keyboard functions are located on the keyboard panel. The keyboard unit has 45 keys consisting of 26 alphabetics (A through Z); 10 numerics (0 through 9); comma; period; dash (–); backspace (←); forward space (→); cursor return (CR); space (SP); home cursor (HC); and mode. The **MODE** key selects either the data entry mode or the calculator mode.

Alternate functions are available for 13 keys: Clear (**CLR**); roll up (↑); clear entry (**CLE**); enter (**ENTER**); sign change (+/-); exchange (⇅); delete line (**DEL**); set beginning of stack (**SBS**); beginning of stack (**BOS**); and the arithmetic operations (+, –, x, ÷). The alternate functions, operational only during the calculator mode, display above the affected keys.



1. ON/OFF Power Switch
2. Data Entry Keyboard

Figure 3C-9. Pilot Entry Keyboard

WARNING

To prevent electromagnetic radiation in ramp, terminal, taxiway, or other areas occupied by personnel, operate radar only in STANDBY mode.

CAUTION

Pilot entry keyboard ON / OFF Switch must be in OFF position whenever keyboard is being connected to, or being disconnected from, aircraft connector.

Do not operate radar system, even in STANDBY Mode, without 115-Vac, 400-Hz power applied to the system. Without ac power, the receiver/transmitter/cooling blower will not operate, which could result in circuit damage and/or automatic shutdown.

(14) Keyboard Operation. After turning on the radar, set the rotary switch on the Data NAV Control Unit to **EMER INDEX**.

1. Slide keyboard **ON / OFF** Switch to **ON**.

2. Use **PAGE** buttons and **LINE** push buttons, if necessary, to place cursor on **PILOT INPUT** line of index.

3. Set rotary switch to **EMER LIST** position to display **PILOT INPUT** page.

(15) Page Sequencing. The **PAGE** push button must be used to advance to each page of the pilot input and to cycle back to the first page. All keyboard actions are limited to the currently displayed page. There is no automatic paging to the previous or next page with cursor movement or by means of the →, ←, or **CR** keys.

(16) Mode Assignment. By use of the keyboard **MODE** key, a mode can be chosen for each pilot-input page. For instance, the pilot can select Data Entry mode for page 1; advance to page 2 and select Data Entry mode; and advance to page 3 and select Calculator mode for page 3. The mode assignment is retained for each page as page advancing occurs.

When power is first applied to the radar system, the pilot-input pages are cleared and each page is set to the data entry mode, unless data has previously been entered, in which case the memory is preserved and not cleared. Successively pressing the **MODE** key alternates the mode between data entry and calculator.

(17) Exit And Return To Keyboard Operation. Checklist operation can be resumed by setting the rotary switch to **NORM INDEX** / **NORM LIST** / **EMER INDEX**. When keyboard operation is again selected, the screen returns to the same display conditions that prevailed prior to leaving the keyboard operation.

NOTE

To clear the screen, enter the calculator mode and press the CLR key. This two-key operation is a deliberate requirement to avoid an accidental clearing of the screen.

(18) Detailed Operation. The keyboard unit can be operated in two modes: data entry and calculator. In the data entry mode, the unit is essentially used as a typewriter; press a key and the key symbol is displayed on the screen. In the calculator mode, arithmetic operations can be performed and the results saved.

(19) Data Entry Mode. Data can be entered in columns 2 through 21 on lines 3 through 12. This data-entry region contains a maximum of 10 lines with 20 characters per line. Data is entered at the location on the screen where the cursor is positioned. When keyboard operation is selected, the first pilot-input page is displayed with the cursor positioned to column 2, line 3.

The keyboard cursor displays only in the data entry mode. It is a small horizontal blue line where there are no characters, but when it resides on a character, it changes the color of the character to blue.

Pressing any of the alphabetic, numeric, comma, period, dash, or space keys, will make that character display in the cursor position and the cursor will advance to the next character location on the line. If the cursor was in the last location of a line, it will advance to the start of the next line in the data entry region. If the cursor was in the last location of the last line, it will advance to the start of the first line in the data entry-region.

Each time the → key is pressed, the cursor is advanced to the next location. Each time the ← key is pressed, the cursor is backspaced to the previous location. If the cursor was at the start of a line, it will backspace to the last location of the previous line. If the cursor was at the start of the first line in the data entry region, it will backspace to the last location on the last line.

The **CR** key advances the cursor to the start of the next line. If the cursor was in any location on the last line, pressing the **CR** key will position the cursor to the start of the first line in the data entry region (column 2, line 3). The **HC** key returns the cursor to the start of the first line in the data entry region (column 2, line 3).

(20) Calculator Mode. Only the numeric, ←, →, **HC**, period, and mode keys and the keys printed with alternate functions on the keyboard face are active during the calculator mode.

If the calculator mode is selected for any of the three pilot-input pages after power on initialization, an asterisk will display in column 1, line 2 and a separator (∧) in red will display in its standard position in column 11, line 2. Line 2 is the numeric entry line in the calculator mode. The separator marks the extent of the number that can be entered to the right of the separator.

(a) Numeric Keys, Period, and Sign Change. Each time a numeric key is pressed, the number displays in the rightmost location of the numeric entry line. Any previously entered data is shifted to the left. A number can include a decimal point (period) and a sign. Numbers can be entered to within one space to the right of the separator. This space is reserved for the sign when a maximum number of digits is entered. All numbers are assumed to be positive as they are entered. A positive number has a space rather than a + sign preceding it, whereas a negative number has a – as the leading character. After a number is entered, the sign can be changed by pressing the V key whose alternate function is shown as "+/-" for the calculator mode. If an attempt is made to enter a number that is too large to fit to the right of the separator, the leftmost character will be lost as the new character enters from the right.

(b) Enter Function. When the **U** key is pressed, the enter function is requested. By using the enter function, up to 10 lines of information can be restored on the screen below the numeric entry line. These 10 storage lines are referred to as a data stack. The asterisk in column 1 indicates the beginning of the stack. The line following the asterisk is the end of the stack. Each time the enter function is requested, the end of the stack is cleared and all the data on the screen down through the beginning of the stack (designated by the asterisk in column 1) is moved down one line, leaving the numeric entry line cleared. When the beginning of the stack reaches the last line on the screen, no more data can be entered into the stack.

(c) Roll Up. When the **P** key is pressed, the roll up function is requested. The roll up function rolls all the data on the numeric entry line down to the bottom of the page, and moves all the other data on the screen up one line.

(d) Exchange Function. When the **W** key is pressed, the exchange function is requested. This function exchanges only the number to the right of the separator on the numeric entry line with the number on the next (third) line.

(e) Clear Entry Function. When the **S** key is pressed, the clear entry function is requested. this function clears only the number to the right of the separator on the numeric entry line. No other data is affected.

(f) Delete Line Function. When the **X** key is pressed, the delete line function is requested. This function deletes all the data on the numeric entry line and moves the data on the bottom line of the screen to the numeric entry line. All the lines from the end of the stack (the line following the asterisk) to the bottom of the page are moved down by one line and a blank line is entered at the end of the stack.

If the beginning of the stack (identified by an asterisk in column 1) is at the bottom of the page, no action occurs when the delete line function is requested. In this case, the numeric entry line contains the end of the stack whose number can be cleared by pressing **CLE**.

(g) Beginning Of Stack (BOS) Function. When the **CR** key is pressed, the BOS function is requested. This function rolls up each line on the screen until the beginning of stack line displays in the numeric entry line.

(h) Set Beginning of Stack (SBS) Function. When the **Y** key is pressed, the SBS function is requested. When this function is requested, the asterisk designating the beginning of the stack is cleared from its current position and set to column 1 line 2, the numeric entry line.

(i) Add Operation. When the **Z** key is pressed, this operation adds the number on the numeric entry line to the number on the third line and replaces the number on the third line with the result. The number on the numeric entry line is cleared.

(j) Subtract Operation. When the **-** key is pressed, this operation subtracts the number on the numeric entry line from the number on the third line and replaces the number on the third line with the

result. The number on the numeric entry line is cleared.

(k) Multiply Operation. When the **SP** key is pressed, this operation multiplies the number on the numeric entry line by the number on the third line and replaces the number on the third line with the result. The number on the numeric entry line is cleared.

(l) Divide Operation. When the (**,**) key is pressed, this operation divides the number on the third line by the number on the numeric entry line and replaces the number on the third line with the result. The number on the numeric entry line is cleared.

(m) Forward Space and Backspace Keys. These keys can be used to change the position of the separator on the numeric entry line in order to decrease or increase the extent of the numbers that can be entered into the numeric entry line. Each time the → key is pressed, the separator moves one position to the right and replaces any character that may have been in that location. The separator cannot be moved beyond column 19. This allows space for the entry of at least one digit and a sign.

Each time the ← key is pressed, the separator moves one position to the left and replaces any character that may have been in that location. The separator cannot be moved beyond column 2. This allows space for the asterisk in column 1.

(n) Home Function. When the **HC** key is pressed, the separator is returned (homed) to the standard position (column 11) on the numeric entry line. Any character that was present in that location is replaced by the separator.

(o) Arithmetic Results. When an arithmetic operation (+, –, x, ÷) is performed on two numbers and the result is greater than the number of digits allowed to the right of the separator, the message OVERFLOW will display on the third line instead of the result. When an arithmetic operation (+, –, x, -) is performed on two numbers, with at least one containing a decimal point, the result will include the sign and all the digits to the left of the decimal point and as many digits to the right of the decimal point as can fit into the remaining space. Those digits that cannot be fit in are truncated, so that no round off occurs in the least significant digit in column 21.

(p) Clear Function. When the **D** key is pressed, all the data on the page is cleared, the asterisk is set to column 1 on the numeric entry line, and the separator is set into the standard position (column 11) on the numeric entry line.

(q) Mode Function. When the **MODE** key is pressed during the calculator mode, the numeric entry line is cleared, including the separator; the asterisk is cleared only if it is on the numeric entry line; the cursor is positioned to the start of the data entry region; and the mode is changed to data entry. When the **MODE** key is pressed again, the cursor is removed from the screen; the separator displays in the standard position (column 11 of the numeric entry line); the beginning of stack is returned to the numeric entry line unless it was already present elsewhere; and the mode is changed to calculator.

3C-17. HORIZONTAL SITUATION INDICATOR.

a. Description. The Horizontal Situation Indicator (HSI) combines numerous displays to provide a map-like presentation of the aircraft position. The indicator displays aircraft displacement relative to VOR, localizer, glideslope beam, TACAN, and heading as selected by the HSI selector switches located outboard of each HSI with respect to magnetic north. Any warning flag in view indicates the respective (NAV or HDG) information is unreliable. Refer to Figure 3C-10.

NOTE

Aircraft HSI circuitry modified by Beech Service Instruction No. C-12-0118 will operate as follows: In addition to the standard warning flag conditions. If a TACAN circuitry 26 Vac power loss occurs and TACAN is selected, the HSI bearing pointer (OSA only) will drive to the Park position and the NAV flag (ANG and OSA) will drop into view.

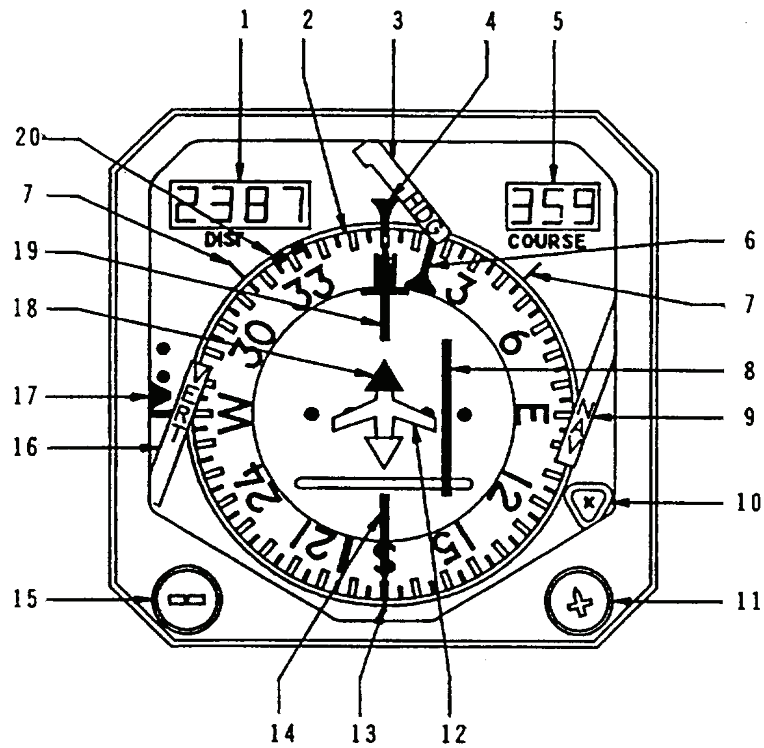
Deviation relays of the VOR/LOC and TACAN systems are monitored by a failure warning system. During ILS operation, the GLS-1 and GLS-2 relays are also monitored. The **HSI NAV** and/or **VERT** flags will display when a relay or relays of the system selected for display fails.

b. Controls, Functions, and Indicators.

(1) Distance Display – Provides digital displays of DME or TACAN. DME and TACAN distance is displayed in 1/10-mile increments.

(2) Rotating Heading Dial – Displays gyro stabilized magnetic compass information on a dial which rotates with the aircraft throughout 360°. The azimuth ring is graduated in 5° increments.

(3) Heading Warning Flag – When in view, indicates the heading information is unreliable.



1. **Distance Display**
2. **Rotating Heading Dial**
3. **Heading Warning Flag**
4. **Fore Lubber Line Marks**
5. **Course Display**
6. **Bearing Pointer (OSA Only)**
7. **Azimuth Marks**
8. **Course Deviation Bar**
9. **Navigation Warning Flag**
10. **Compass Sync Annunciator**
11. **Course Knob Positions**
12. **Aircraft Symbol**
13. **Aft Lubber Line**
14. **Reciprocal Course Pointer**
15. **Heading Knob**
16. **Vertical Warning Flag**
17. **Vertical Deviation Pointer**
18. **To/From Pointer**
19. **Course Select Pointer**
20. **Heading Bug**

Figure 3C-10. Horizontal Situation Indicator

(4) Fore Lubber Line Marks – Fixed heading mark at the fore positions.

(5) Course Display – Provides a digital readout of selected course.

(6) Bearing Pointer **OSA** – Provides magnetic bearing to VOR or TACAN ground based navaids as selected by the HSI source selector push switches.

(7) Azimuth Marks – Azimuth marks are fixed at +45° from fore lubber line.

(8) Course Deviation Bar – Represents the centerline of the selected VOR or localizer course. The aircraft symbol pictorially shows actual aircraft position in relation to this selected course.

(9) Navigation Warning Flag – When in view, indicates the navigation information, i.e., lateral steering is unreliable.

(10) Compass Synchronization Annunciator – Consists of the symbol ● or **X** (dot or cross) displayed in a window. When the compass system is in the slaved mode, the display will oscillate between the ● and **X**, indicating the heading dial is synchronized with gyro stabilized magnetic heading.

(11) Course Knob Positions – A yellow course pointer to select a magnetic bearing that coincides with the desired VOR radient or localizer course.

(12) Aircraft Symbol – The fixed miniature aircraft symbol corresponds to the longitudinal axis of the aircraft and lubber line markings. The symbol

shows aircraft position and heading with respect to a radio course and rotating heading dial.

(13) Aft Lubber Line – Fixed heading mark at the aft position.

(14) Reciprocal Course Pointer – Positioned on the heading dial in a direction 180° from the course pointer.

(15) Heading Knob – Positions the heading bug on the rotating heading dial and displays pre-selected compass heading.

(16) Vertical Warning Flag – When in view, indicates the vertical information is unreliable.

(17) Vertical Deviation Pointer – Displays glideslope deviation. Pointer is in view only when tuned to a localizer frequency. Aircraft is below glide path if pointer is displaced upward and each dot represents approximately 0.4° displacement.

(18) To-From Pointer – Two flags, 180° apart. One always points in the direction of the station along the selected VOR radial.

(19) Course Pointer – Like the heading bug, the course pointer also rotates with the heading dial to provide a continuous readout of course error to the computer. When one of the radio modes is selected, the vertical command bar in the ADI will display bank commands to intercept and maintain the selected radio course.

(20) Heading Bug And Heading Knobs – The notched orange heading bug rotates with the heading dial so the difference between the bug and the fore lubber line index is the amount of heading error applied to the flight director computer. In the heading mode, the ADI will display the proper bank commands to turn to and maintain this selected heading.

c. HSI Failure Warning System. The HSI failure warning system monitors and compares lateral steering signals for VOR, ILS, localizer, TACAN. The system also monitors and compares vertical steering signals for ILS glideslope. Lateral steering failures are displayed by the HSI NAV flag, and vertical steering failures are displayed by the HSI VERT (glideslope) flag.

The system provides independent failure warning capabilities and failure warning test switches for both pilot and copilot. Failure warning priority is provided for failures within the active NAV receiver. The pilot and copilot test switches are on the autopilot/flight director transfer panel located on the extended pedestal.

The circuit receives 28 Vdc power from the #1 and #2 avionics buses routed through each respective navigation receiver, i.e., **NAV 1 / NAV 2, TACAN.** This design provides a built-in power redundancy since only one navigation receiver is required to be operating at any given time to provide sufficient power for effective failure warning to exist. Once active, the failure warning system automatically monitors steering signals for the navigation system selected by the operator and displayed on the HSI.

The EFWS monitors the failure prone circuits of the Course Deviation Indicator (CDI) system. The CDI system receives input from the VOR/LOC, TACAN, and GLS (Glideslope systems) through a common printed circuit (PC) board. The EFWS compares these input signals to an expected output signal. If the signals do not match, this indicates failure of the switching relays, connector pins, or the PC board traces for the LT / RT or UP / DN deviation steering signals and the appropriate warning flags are displayed. The EFWS cannot determine if the input signals are unreliable; therefore, the EFWS will not detect a failure of the VOR/LOC, TACAN, or ANTENNA systems. It will not detect a failure of their associated wiring, connectors, or switching relays. In addition, the EFWS will not detect a failure inside the CDI.

The failure warning system includes an individual and separate self-test circuit for the pilot and copilot. Once activated, the self-test circuit will bias both VERT and NAV flags in view when the deviation exceeds +7.5 millivolts. The flags will bias out of view when the deviation is less than +7.5 millivolts, or when the self-test circuit is de-energized (provided a valid signal is being received).

A failure flag is displayed when the NAV signals monitored by the HSI failure warning system differ by more than 7.5 millivolts for both lateral and vertical deviation. Filtering is provided to eliminate false warnings due to excessive noise and/or spurious signals caused by switching or electromagnetic interference.

NOTE

7.5 millivolts correspond to approximately 0.1 dot displacement of the CDI and GS indicator bars.

3C-18. AUTOMATIC FLIGHT CONTROL SYSTEM.

a. Description. The Automatic Flight Control system is a completely integrated autopilot/flight director/air data system that has a full complement of horizontal and vertical flight guidance modes. These include all radio guidance modes, and air data oriented vertical modes.

When engaged and coupled to the flight director commands, the system will control the aircraft using the same commands displayed on the attitude director indicator. When engaged and uncoupled from the flight director commands, manual pitch and roll commands may be inserted using the Touch Control Steering (TCS) or the pitch wheel and turn knob. System limits are shown in Table 3C-1.

When the autopilot is coupled, the flight director instruments act as a means to monitor the performance of the autopilot. When the autopilot is not engaged, the same modes of operation are available for flight director only. The pilot maneuvers the aircraft to satisfy the FD commands, as does the autopilot when it is engaged.

NOTE

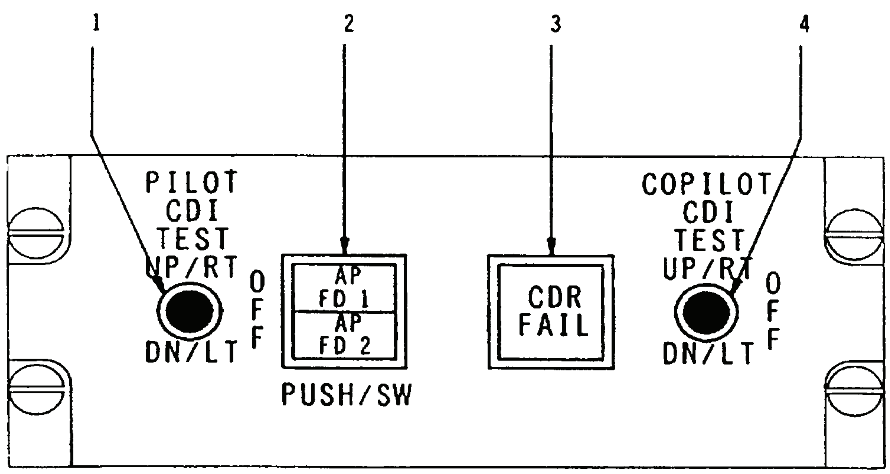
The autopilot will disengage when transferring between the pilot and copilot flight directors.

b. Autopilot Flight Director Transfer Panel. Refer to Figure 3C-11. A panel containing an alternate action autopilot and flight director transfer switch, placarded **AP FD 1** and **AP FD 2**, is located on the pedestal extension. This switch is used to select which autopilot flight director computer controls the aircraft flight servos. If **AP FD 2** is selected, the annunciators placarded **AP FLT DIR NO. 2**, located above the pilot's and copilot's ADI's, will illuminate to alert both pilots that the No. 2 autopilot flight director computer is controlling the aircraft. The **NO. 1 AP FD** is not annunciated.

NOTE

If VOR is selected on both the pilot and copilot HSI's, the DME readout and Radar NAV display will accompany the selected autopilot flight director.

c. Air Data Computer. A digital air data computer, located in the forward avionics compartment, provides the altitude information for the pilots' servoed altimeter, altitude alerter, flight data recorder, and transponder. The computer also provides altitude and airspeed hold function data to the flight control computers, generates and provides total airspeed, static/total air temperature to the **TAS / SAT /TAT** indicator with inputs from the airspeed/ temperature probe. The air data computer receives 28 Vdc power through, and is protected by, a 2-ampere circuit breaker, placarded **AIR DATA ENCODER**, located in the avionics section of the circuit breaker panel. All air data computer functions are automatic in nature and require no flight crew action.



1. **Pilot's CDI Failure Warning Test Switch**
2. **AP Flight Director Transfer Switch**
3. **Crash Data Recorder Fail Light**
4. **Copilot's CDI Failure Warning Test Switch**

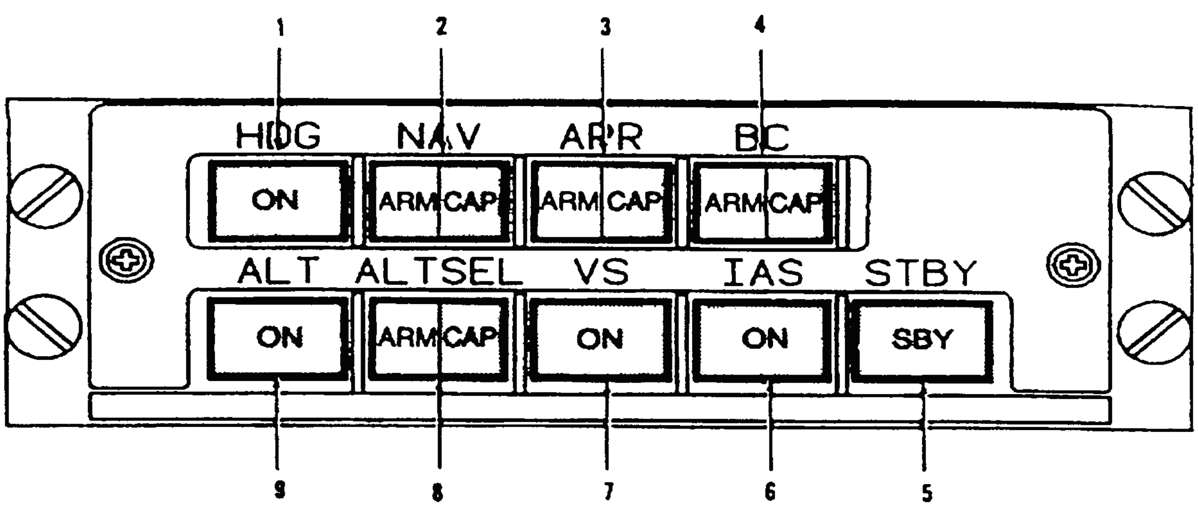
Figure 3C-11. Autopilot/Flight Director Transfer Panel

d. Flight Director/Mode Selector. Refer to Figure 3C-12. This provides all mode selection, except go-around that is initiated by a remote switch, for the flight director. The top row of light annunciated push buttons contains the lateral modes and the bottom row contains the vertical modes. The split light push buttons illuminate yellow for armed conditions and green for captured. When more than one lateral or vertical mode is selected, the flight director system automatically arms and captures the submode. The mode annunciations are repeated on the remote annunciator blocks above both ADI's, with the addition of **GS ARM**, **GS CAP**, **AP ENG**, **YD ENG** and **GA**.

(1) Heading Mode Selector. The Heading Select Mode is selected by pressing the **HDG** button on the mode selector. The **HDG** annunciator illuminates. In the HDG mode, the flight director computer provides inputs to the command cue to command a turn to the heading indicated by the heading bug on the HSI. The heading select signal is gain programmed as a function of airspeed. When **HDG** is selected, it overrides the Nav, BC APR and VOR APR modes. In the event of a loss of valid signal from the VS or compass, the command cue is biased out of view.

(2) Navigation (NAV) Mode Selector. The NAV represents a family of modes for various navigation systems including VOR, Localizer, TACAN or VLF as selected by the HSI selector switches.

(a) VOR Mode. The VOR Mode is selected by pressing the **NAV** button on the mode selector with the navigation receiver tuned to a VOR frequency and DME greater than 20 miles from the station. Prior to VOR capture, the command cue receives a heading select command, as described above, and the **HDG** mode annunciator on the mode selector is illuminated along with the **NAV ARM** annunciator on the mode selector. Upon VOR capture, the system automatically switches to the VOR mode **HDG** and **NAV ARM** annunciators extinguish and NAV capture **NAV CAP** annunciator on the mode selector will illuminate. At capture, a command is generated to capture and track the VOR beam. VOR deviation is gain programmed as a function of distance from the station. This programming corrects for beam convergence thus optimizing the gain through the useful VOR range. To utilize this feature, the DME must be tuned to the same VOR station as the NAV receiver, which is feeding the flight director. The course error signal is gain programmed as a function of airspeed. Crosswind washout is included, which maintains the aircraft on beam center in the presence of crosswind. The intercept angle and DME distance are used in determining the capture point to ensure smooth and comfortable performance during bracketing.



1. **Heading Mode Selector**
2. **Navigation Mode Selector**
3. **Approach Mode Selector**
4. **Backcourse Mode Selector**
5. **Standby Mode Selector**
6. **IAS Mode Selector**
7. **VERT Speed Mode Selector**
8. **ALT Pre-Select Mode Selector**
9. **ALT Hold Mode Selector**

Figure 3C-12. Flight Director/Mode Selector

When passing over the station, an overstation sensor detects station passage removing the VOR deviation signal from the command until it is no longer erratic. While over the station, course changes may be made by selecting a new course on the HSI. If the NAV receiver is not valid prior to the capture point, the lateral beam sensor will not trip and the system will remain in the HDG mode. After capture, if the **NAV** receiver, compass data or vertical gyro go invalid, the command cue will bias out of view. The **NAV CAP** annunciator on the mode selector will extinguish if the **NAV** receiver becomes invalid.

(b) VOR Approach Mode. The VOR approach mode is selected by pressing the **NAV** button on the mode selector with the navigation receiver tuned to a VOR frequency and less than 20 DME miles from the station. The mode operates identically to the VOR mode with the gains optimized for a VOR approach.

(c) Localizer Mode. The localizer mode is selected by pressing the **NAV** button on the mode selector with the navigation receiver tuned to a LOC frequency. Mode selection and annunciation in the LOC mode is similar to the VOR mode. The localizer deviation signal is gain programmed as a function of radio altitude, time and airspeed. If the radio altimeter is invalid, gain programming is a function of glideslope capture, time and airspeed. Other valid logic is the same as the VOR mode.

(3) Approach Mode Selector. The Approach (APR) mode is used to make VOR, TACAN, localizer, and ILS approaches. This mode is more sensitive than the NAV mode.

(a) Localizer Approach Mode. The approach mode is used to make an ILS approach. Pressing the **APR** button, with a LOC frequency tuned, arms both the localizer and glideslope modes. No alternate NAV source can be selected and the NAV receiver must be tuned to an ILS frequency. When the **APR** button is pressed and the above conditions are met, both the NAV and APR modes are armed to capture the localizer and glideslope, respectively. Operating LOC mode is the same as described above except, if the radio altimeter is invalid in APR mode, gain programming is a function of glideslope capture, time, and airspeed.

With the APR mode armed, the pitch axis can be in any one of the other pitch modes except go-around. When reaching the vertical beam sensor trip point, the system automatically switches to the glideslope mode. The pitch mode and **APR ARM** annunciators extinguish and **APR CAP** annunciator illuminates on the controller. At capture, a command is generated to asymptotically approach the glideslope beam. Capture can be made from above or below the beam. The glideslope gain is programmed as a function of radio altitude, time and airspeed. The **APR CAP** annunciator on the mode selector will extinguish if the GS receiver becomes invalid after capture.

Glideslope capture is interlocked so that the localizer must be captured prior to glideslope capture. If the glideslope receiver is not valid prior to capture, the vertical beam sensor will not trip and the system will remain in the pitch mode. After capture, if the NAV receiver, GS receiver, compass data or vertical gyro becomes invalid, command cue will bias out of view. If the radio altimeter is not valid, the glideslope gain programming is a function of GS capture, time and airspeed.

(4) Back Course Mode Selector. The Back Course (BC) mode is selected by pressing the **BC** button on the mode selector. The normal front course for the localizer beam is set for the selected course. Back course operates the same as the LOC mode with the deviation and course signals reversed to make a back course approach on the localizer. When **BC** is selected, and outside the lateral beam sensor trip point, **BC ARM** and **HDG** will be annunciated on the mode selector. At the capture point, **BC CAP** will be annunciated with **BC ARM** and **HDG** extinguished. When **BC** is selected, the glideslope circuits are locked out.

(5) Standby Mode Selector. Standby (SBY) Mode is selected by pressing the **SBY** button on the mode selector. These resets aid the other flight director modes and biases the command cue from view. While pressed, **SBY** acts as a lamp test causing all mode annunciators to illuminate and the flight director warning flag on the ADI to come in view. When the button is released, the mode annunciator lights extinguish and the flight director warning flag retracts from view.

(6) Indicated Airspeed Hold Mode Selector. The Indicated Airspeed (IAS) hold mode is selected by pressing the **IAS** button on the mode selector. When IAS is selected, it overrides the APR CAP, GA, ALT, VS, ALTSEL CAP, or PITCH HOLD modes. In the IAS mode, the pitch command is proportional to airspeed error provided by the air data computer. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new airspeed hold reference without disengaging the mode. Once engaged in the IAS mode, the mode will be reset if the air data computer is not valid and the command cue will bias out of view if the VS is not valid.

(7) Vertical Speed Hold Mode Selector. The Vertical Speed (VS) is selected by pressing the **VS** button on the mode selector. When VS is selected, it overrides the APR CAP, GA, ALT, ALTSEL CAP, IAS, or PITCH HOLD modes. In the VS mode, the pitch command is proportional to VS error provided by the air data computer. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new VS reference without disengaging the mode. Once engaged in the VS mode, the mode will be reset if the air data computer is not valid and the command cue will bias out of view if the VS is not valid.

(8) Altitude Pre-select Mode Selector. The Altitude Pre-select (ALTSEL) *Mode* is selected by pressing the **ALTSEL** button on the mode selector. The desired altitude is selected on the altitude pre-select controller. Pitch hold, VS or IAS may be selected as a mode to fly to the selected altitude. When outside the altitude bracket trip point, the **ALTSEL ARM** annunciator, along with the selected pitch mode, is illuminated on the mode selector. When reaching the bracket altitude, the system automatically switches to the ALTSEL CAP mode and the previously selected pitch mode is canceled. At bracket, a command is generated to asymptotically capture the selected altitude. When the altitude is reached, the ALTSEL CAP mode is automatically canceled and the FD switches to the ALT hold mode. If the air data computer is not valid, the altitude pre-select mode cannot be selected. The command cue will bias out of view if the VG is not valid.

(9) Altitude Hold Mode. The Altitude Hold Mode (ALT) is selected by pressing the **ALT** button on the mode selector. When ALT is selected, it overrides the APR CAP, GA, IAS, VS, ALTSEL CAP, or PITCH HOLD modes. In the ALT mode, the pitch command is proportional to the altitude error provided by the air data computer. The altitude error signal is gain programmed as a function of airspeed. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new altitude hold reference without disengaging the mode. Once engaged in the altitude hold mode, the mode will be reset if the air data computer is not valid and the command cue will bias out of view if the VG is not valid.

NOTE

If the Baro setting on the altimeter is changed, a command is generated to fly the aircraft back to the original altitude reference.

e. Other Mode Selection.

NOTE

The TACAN receiver must be tuned to a valid TACAN frequency. TACAN functions are identical to VOR using TACAN information rather than VOR signals. The ARM / CAP annunciation is the same as in VOR mode.

(1) TACAN Mode. The TACAN mode is selected by pressing the HSI source selector **TACAN** button. TACAN navigation information is then selected and displayed on the HSI by pressing the respective **HSI TACAN** button.

(2) Pitch Hold Mode. Whenever a roll mode is selected without a pitch mode, the command cue will display a pitch attitude hold command. The pitch attitude can be changed by pressing the **TCS** button on the control wheel and maneuvering the aircraft. The command cue will be synchronized to zero while the button is pressed. Upon release of the button, the pitch command will be such as to maintain the new pitch attitude. In the pitch hold mode, the command cue will be biased out of view if the VG is not valid.

(3) Go-Around (GA) Mode. The GA is selected by pressing the remote go-around switch. When selected, all other modes are reset and the remote go-around annunciator **GA** is illuminated. The command cue receives a wings level command, zero command when roll is zero. The command cue also receives the go-around command which is a 7° pitch up attitude command. Selecting GA disconnects the autopilot. The yaw damper remains on.

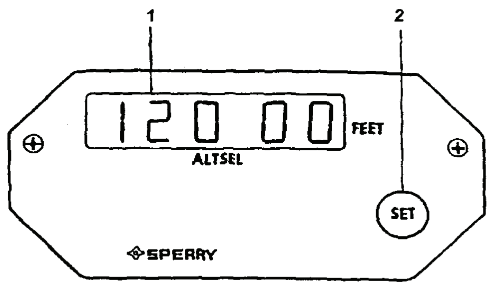
Once go-around is selected, any roll mode can be selected and will cancel the wings level roll command. The go-around mode is canceled by selecting another pitch mode or TCS.

3C-19. ALTITUDE SELECT CONTROLLER.

a. Description. The Altitude Select Controller provides a means for setting the desired altitude reference for the altitude alerting and altitude pre-select system. Refer to Figure 3C-13.

(1) Altitude Alert. As the aircraft reaches a point 1000 feet from the selected altitude, a signal is generated to light the warning light on the altimeter and sound a warning horn for 1 second. This light remains on until the aircraft is 300 ± 50 feet from the selected altitude. If the aircraft now deviates by 300 ± 50 feet or more from the selected altitude, the light is again energized and the horn is sounded. The light remains on until the aircraft returns to within 300 ± 50

feet or deviates more than 1000 feet from the selected altitude.



1. **Selected Altitude Display**
2. **Altitude Selector Knob**

Figure 3C-13. Altitude Select Controller

(2) The altitude is selected by turning the selector knob until the altitude display reads the desired value. No further action is taken on the controller. To initiate altitude pre-select, the **ALTSEL** button is selected on the flight director controller. The pilot must initiate a maneuver to fly toward the pre-selected altitude. Any of the following pitch modes may be engaged: Pitch Hold, Airspeed Hold or Vertical Speed Hold. Upon initiation of altitude pre-select capture, the previously selected pitch mode is automatically reset.

3C-20. AUTOPILOT CONTROLLER.

a. Description. The autopilot provides the means of engaging the autopilot and yaw damper, as well as manually controlling the autopilot through the turn knob and pitch wheel. The autopilot system limits are provided in the Autopilot System Limits Table. Refer to Table 3C-1.

(1) Pitch Wheel. Movement of the pitch wheel will cancel only ALT HOLD and ALTSEL CAP. With vertical modes of VS or IAS selected on the mode selector, rotation of the pitch wheel will change the respective displayed vertical mode reference. VS or IAS mode may be canceled by pressing the mode button on the mode selector. If VS or IAS is not selected, the pitch wheel works as described above. The pitch wheel is always disabled during a coupled glideslope. Refer to Figure 3C-14.

(2) Bank Limit. Selection of the bank limit mode on the autopilot controller provides a lower maximum bank angle while in the HDG mode. **LOW** will illuminate on the **BANK LIMIT** switch. The lower bank limit is inhibited and **LOW** is extinguished during NAV mode captures. If HDG is again engaged, **BANK LIMIT** will again be illuminated. Pressing **BANK LIMIT** when illuminated will return autopilot to normal bank limits.

(3) ***SOFTRIDE*** *Push Button.* Softride reduces autopilot gains while still maintaining stability in rough air. This mode may be used with any FD mode selected.

(4) ***TURN*** *Knob.* Rotating the **TURN** knob out of detent results in a roll command. The roll angle is proportional to, and in the direction of, the **TURN** knob rotation, the turn knob must be in detent (center position) before the autopilot can be engaged. Rotating the turn knob cancels any other previously selected lateral mode.

(5) ***YD ENGAGE*** *Push Button.* When the autopilot is not engaged, the yaw damper may be utilized by pressing the **YD ENGAGE** push button.

Table 3C-1. Autopilot System Limits

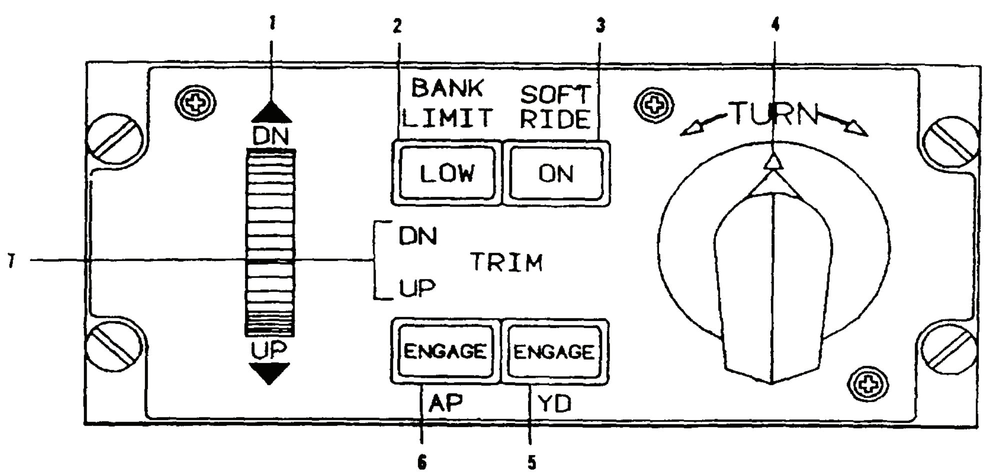
MODE	CONTROL OR SENSOR	PARAMETER	VALUE
Yaw Damper	Yaw Control	Engage Limit	Unlimited
AP Engage		Engage Limit	Roll Up to ± 90°
			Pitch Up to ± 30°
Basic AP	Touch Control Steering TCS	Roll Control Limit	Up to ± 45° Roll
			Up to ± 25° Pitch
	Turn Knob	Roll Angle Limit	± 30°
		Roll Rate Limit	± 15°/sec
	Pitch Wheel	Pitch Angle Limit	± 15° Pitch
	Heading Hold	Roll Angle Limit	Less than 6° and no roll mode selected.

Table 3C-1. Autopilot System Limits (Continued)

MODE	CONTROL OR SENSOR	PARAMETER	VALUE
Heading Select	Heading SEL	Roll Angle Limit	± 25°
	Knob on HSI	Roll Rate Limit	± 3.5°/sec
VOR	Course Knob, NAV Receiver and DME	***CAPTURE***	
		Beam Angle Intercept (HDG SEL)	Up to ± 90°
		Roll Angle Limit	± 25°
		Course Cut Limit at Capture	± 45° Course
		Capture Point	Function of beam, beam rate, course error, and DME distance
		ON COURSE	
		Roll Angle Limit	± 13° Roll
		Crosswind Correction	Up to ± 45° Course Error
		OVER STATION	
		Course Change	Up to ± 90°
		Roll Angle Limit	± 17°
LOC or APR or BC	Course Knob and NAV Receiver	***LOC CAPTURE***	
		Beam Intercept	Up to ± 90°
		Roll Angle Limit	± 25°
		Roll Rate Limit	± 5°/sec
		Capture Point	Function of Beam, Beam Rate and Course Error
		NAV ON-COURSE	
		Roll Angle Limit	± 17° Roll
		Crosswind Correction Limit	± 30° of course error
		Gain Programming	Function of Time and (TAS) starts at 1200 feet radio altitude
	GS Receiver and Air Data Computer	**GLIDESLOPE CAPTURE**	
		Beam Capture	Function of beam and beam rate.
		Pitch Command Limit	± 10°
		Glideslope Damping	Vertical Velocity
		Pitch Rate Limit	Function of (TAS)
		Gain Programming	Function of Time and (TAS) Starts at 1200 ft radio altitude.
			Function of (Radio Alt) Starts at 250 ft.
GA	Control Switch on Power Lever	Fixed Pitch-Up Command, Wings Level	7° Pitch Up

Table 3C-1. Autopilot System Limits (Continued)

MODE	CONTROL OR SENSOR	PARAMETER	VALUE
Pitch Sync	TCS Switch on Control Wheel	Pitch Attitude Command	± 20°
ALT Hold	Air Data Computer	ALT Hold Engage Range	0 to 50,000 ft
		ALT Hold Engage Error	± 20 ft
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)
VS Hold	Air Data Computer	VERT Speed Engage Range	0 to ± 6000 ft/min
		Engage Error	± 30 ft
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)
IAS Hold	Air Data Computer	IAS Engage Range	80 to 450 knots
		IAS Hold Engage Error	± 5 knots
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)
ALT Pre-select	Air Data Computer	Pre-select Capture Range	0 to 50,000 ft
		Maximum Vertical Speed for Capture	± 4000 ft/min
		Maximum Gravitational Force	± .2g
		During Capture Maneuver	
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)



1. **Pitch Wheel**
2. **BANK LIMIT Selector/Light**
3. **SOFT RIDE Switch**
4. **TURN Knob**
5. **Yaw Damp ENGAGE Push Button**
6. **Autopilot ENGAGE Push Button**
7. **Elevator TRIM Annunciator**

Figure 3C-14. Autopilot Controller

*(6) **AP ENGAGE** Push Button.* The engage switch is used to engage the autopilot. Engaging the autopilot automatically engages the yaw damper. The autopilot may be engaged with the airplane in any reasonable attitude. The autopilot is normally disengaged by momentarily pressing the control wheel **AP DISC** switch. The autopilot may also be disengaged by any of the following actions.

1. Actuation of the control wheel **AP DISC** button. Disengagement is confirmed by five flashes of the **AP ENG** annunciator.

2. Pressing the respective vertical gyro **FAST ERECT** button.

3. Actuation of respective compass **INCREASE / DECREASE** switch.

4. Selection of Go-Around mode. Disengagement is confirmed by the **AP ENG** annunciator flashing five times and illumination of the **GA** annunciators.

5. Pulling the autopilot **AP CONTROL** circuit breaker.

6. Pressing the autopilot **AP ENGAGE** push button.

7. When transferring between pilot and copilot flight directors.

Any of the following malfunctions will cause the autopilot to automatically disengage.

1. Vertical gyro failure.

2. Directional gyro failure.

3. Autopilot power or circuit failure.

(7) Elevator Trim Annunciator. The elevator trim annunciator indicates **UP** or **DN** when a sustained signal is being applied to the elevator servo. The annunciator should not be illuminated before the autopilot is engaged.

3C-21. VHF NAVIGATION RECEIVERS.

a. Description. The VIR-32 Navigation Receiver provides 200 50-kHz spaced VOR/LOC channels from 108.00 through 117.95 MHz and 40 GS channels automatically paired with localizer channels. It also provides a marker beacon receiver.

The digital VIR-32 provide VOR, LOC, and GS deviation outputs, high and low level flag signals, magnetic bearing to the station, to/from information, marker beacon lamp signals, and VOR and marker beacon audio outputs.

CAUTION

When monitoring for marker beacon passage, always listen for marker beacon audio. Do not rely solely on the marker beacon lights.

b. Operating Controls. All operation controls for the VIR-32 are located on the CTL-32 NAV control. Refer to Figure 3C-15.

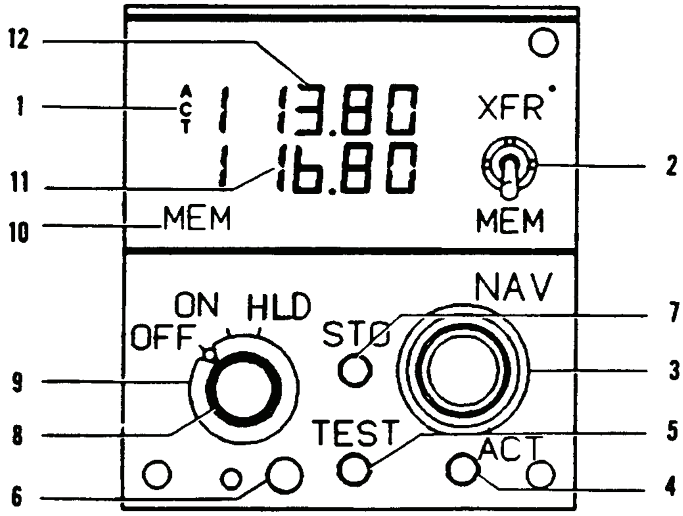
*(1) Compare Annunciator (**ACT**).* **ACT** momentarily illuminates when frequencies are being changed. **ACT** flashes if the actual radio frequency is not identical to the frequency shown in the active frequency display.

*(2) **XFR / MEM** Switch.* This switch is a 3-position, spring-loaded toggle switch. When held to the **XFR** position, the preset frequency is transferred to the active display and the receiver re-tunes. The previously active frequency becomes the new preset frequency and is displayed in the lower window. When this switch is held to the **MEM** position, one of the four stacked memory frequencies is loaded into the preset display Successive pushes cycle the four memory frequencies through the display (…2, 3, 4, 1, 2 ,3…).

(3) Frequency Select Knobs. Two concentric knobs control the preset or active frequency displays. The larger knob changes the three digits to the left of the decimal point in 1-MHz steps. The smaller knob changes the two digits to the right of the decimal point 0.05-MHz steps. Frequencies roll over at the upper and lower limits. The two frequency select switches are independent of each other such that the upper and lower limit rollover of the 0.1-MHz digit will not cause the 1.0-MHz digit to change.

*(4) **ACT** Button.* Push the **ACT** button for approximately 2 seconds to enable the frequency select knobs to directly retune the receiver. The button window will display dashes and the upper window will continue to display the active frequency. Push the **ACT** button a second time to return the control to the normal two-display mode.

*(5) **TEST** Button.* Press the **TEST** button to initiate the radio self-test diagnostic routine. (Self-test is active only when the **TEST** button is pressed.)



1. Compare Annunciator (ACT)
2. XFR/MEM Switch
3. Frequency Select Knobs
4. ACT Button
5. TEST Button
6. Light Sensor
7. STO Button
8. Volume Control
9. Power and Mode Switch
10. Annunciators (MEM, HLD)
11. Preset Frequency Display
12. Active Frequency Display

Figure 3C-15. CTL-32 NAV Control

(6) Light Sensor. The built-in sensor automatically controls the display brightness.

*(7) **STO** Button*. The **STO** button allows up to four preset frequencies to be selected and entered into the control's memory. After presetting the frequency to be stored, push the **STO** button. The upper window displays the channel number of available memory (CH 1 through CH 4); the lower window continues to display the frequency to be stored. For approximately 5 seconds, the **MEM** switch may be used to advance through the channel numbers without changing the preset display. Push the **STO** button a second time to commit the preset frequency to memory in the selected location. After approximately 5 seconds, the control will return to normal operation.

(8) Volume Control. A volume control is concentric with the power and mode switch.

(9) Power and Mode Switch. The power and mode switch contain three detented positions. The **ON** and **OFF** positions switch system power. The **HLD** position allows the NAV frequency to be changed, but holds the DME to the current active frequency.

*(10) **MEM** and **HLD** Annunciators*. The **NAV** control contains **MEM** (memory) and **HLD** (hold) annunciators. The **MEM** annunciator illuminates whenever a preset frequency is being displayed in the lower window. The **HLD** annunciator indicates that the DME is held to the active frequency at time of selection; the NAV frequency may be changed. The upper window now displays the NAV frequency and the lower window displays the held DME frequency.

(11) Preset Frequency Display. The preset (inactive) frequency and diagnostic messages are displayed in the lower window.

(12) Active Frequency Display. The active frequency, frequency to which the VIR-32 Receiver is tuned, and diagnostic messages are displayed in the upper window.

c. Operating Procedures.

CAUTION

It is not practical to provide monitoring for all conceivable system failures. It is possible that erroneous operation could occur without a fault indication. It is the responsibility of the pilot to detect such an occurrence by means of cross-checks with redundant or correlated information available in the cockpit.

(1) Equipment Startup. The VIR-32 receiver and the CTL-32 NAV control are turned on by rotating the power and mode switch on the NAV control to the **ON** position. After power is applied, the CTL-32 displays the same active and preset frequencies that were present when the equipment was last turned off.

(2) Frequency Selection. Frequency selection is made using either the frequency select knobs, or the **XFR / MEM** (transfer/memory recall switch).

Rotation of either frequency select knob increases or decreases the frequency in the present frequency display. The larger, outer knob changes the frequency in 1-MHz increments (number to the left of decimal point). The smaller, inner knob changes the frequency in 0.05-MHz increments.

After the desired frequency is set in the preset frequency display, it can be transferred to the active frequency display by momentarily setting the **XFR / MEM** switch to **XFR**. At the same time that the preset frequency is transferred to the active display, the previously active frequency is transferred to the preset display. The **ACT** annunciator on the control flashes while the receiver is tuning to the new frequency.

NOTE

If the ACT annunciator continues flashing, it indicates that the receiver is not tuned to the frequency displayed in the active display.

The CTL-32 has memory that permits storing up to four preset frequencies. Once stored, these frequencies can be recalled to the preset display by positioning the **XFR / MEM** switch to the **MEM** position. The storage location (CH 1 through CH 4) for the recalled frequency display while the **XFR / MEM** switch is held in the **MEM** position. All four stored frequencies can be displayed one at a time in the preset display by repeatedly positioning the **XFR / MEM** switch to the **MEM** position. After the desired stored frequency has been recalled to the preset display, it can be transferred to the active display by momentarily positioning the **XFR / MEM** switch to the **XFR** position.

During normal operation, all frequency selections and revisions are done in the preset frequency display. However, the active frequency can be selected directly as described in the direct active frequency selection paragraph.

(3) Direct Active Frequency Selection. The active frequency can be selected directly with the frequency select knobs by pushing the **ACT** button for about 2 seconds. The active frequency selection mode is indicated by dashes appearing in the preset display. Also, the **ACT** annunciator will flash as the frequency select knobs are turned to indicate that the receiver is being re-tuned.

NOTE

If the ACT annunciator continues flashing after the frequency has been selected, it indicates that the receiver is not tuned to the frequency displayed in the active display.

To return to the preset frequency selection mode, push the **ACT** button again for about 2 seconds.

As a safety feature, the CTL-32 automatically switches to the active frequency selection mode when a frequency select knob is operated while the **STO**, **TEST**, or **XFR / MEM** switches are actuated.

(4) Frequency Storage. Up to four preset frequencies can be stored in the memory in the CTL-32 for future recall. To program the memory, select the frequency in the preset frequency display using the frequency select knobs and push the **STO** button once. One of the channel numbers (CH 1 through CH 4) will appear in the active display for approximately 5 seconds. During this time, the channel number can be changed, without changing the preset frequency, by momentarily positioning the **XFR / MEM** switch to the **MEM** position. After the desired channel number has been selected, push the **STO** button again to store the frequency.

NOTE

When storing a frequency, the second actuation of the STO button must be done within 5 seconds after selecting the channel number or the first actuation of the STO button. If more than 4 seconds elapse, the control will revert to the normal modes of operation and the second store command will be interpreted as the first store command.

After a frequency has been stored in memory, it will remain there until changed by using the **STO** button. Memory is retained even when the unit is turned off for an extended period of time.

(5) Self-Test. During self-test, the VIR-32 provides VOR, ILS, and marker beacon test outputs. The following paragraphs provide the procedures required and the results to be expected when performing the self-test.

(6) VOR Self-Test.

1. Select a VOR frequency on the NAV Control (a specific frequency is not required for test). A signal on frequency will not interfere with the self-test. Rotate the **OBS** to approximately 0°.

2. Press the **TEST** button on the CTL-32.

3. The **NAV** flag will come into view.

4. After approximately 2 seconds, the flag will go out of view, the **HSI** lateral course deviation bar will approximately center, and a TO indication will display. The **HSI** pointers will indicate approximately a 0° magnetic bearing.

5. The VIR-32 will return to normal operation after approximately 15 seconds, even if the **TEST** button is held.

(7) ILS (Localizer and Glideslope) Self-Test.

NOTE

Anytime an ILS frequency is selected, the HSI bearing pointer will drive to park at the 3 o'clock position.

1. Select a localizer frequency on the CTL-32 NAV Control (a specific frequency is not required for test).

2. Press the **TEST** button on the CTL-32.

3. The **NAV** and **GS** flags will come into view.

4. After approximately 3 seconds, the flags will go out of view, the **HSI** course deviation bar will deflect right approximately 2/3 of full scale, and the glideslope pointer will deflect down approximately 2/3 of full scale.

5. The VIR-32 will return to normal operation after approximately 15 seconds, even if the **TEST** button is held.

(8) Marker Beacon Self-Test. The marker beacon assembly is tested automatically when the self-test is actuated and either a VOR or localizer frequency is selected. Proper operation of the marker beacon assembly is indicated by all three marker lamps lighted (they flicker perceptibly, at a 20-Hz rate). A 20-Hz tone will also be present in the marker audio output.

(9) Marker Beacon Audio. Marker Beacon Audio generally associated with an ILS, must be source selected by the **MKR BCN 1** or **2** audio selector switches located on the audio control panel. Sensitivity selection for marker beacon audio is accomplished by a toggle switch placarded **MKR BCN 1 & 2 HI-LO** located to the right of the color radar.

CAUTION

The diagnostic routines are intended as an extension of the self-test capability. The pilot should first observe the deviation indicators and associated flags for the proper self-test responses. If a fault condition exists, the problem may be verified in more detail by the diagnostics.

(10) Diagnostic Display. An extensive self-test diagnostic routine is also initiated in the VIR-32 by pushing the **TEST** button on the CTL-32. The CTL-32 will modulate the active and preset display intensity from minimum to maximum to annunciate that self-test is in progress. If a fault condition existed prior to actuating self-test, the CTL-32 will display the diagnostic code associated with the fault for approximately 2 seconds immediately after the **TEST** button is pressed. The code will appear in the preset display. If a fault is detected during self-test, that fault code will also be displayed on the CTL-32 along with the word DIAG, FLAG, or four dashes (– – – –) in the active display. The four dashes will be displayed along with the code 00 indicating that no faults have been found. FLAG will be displayed along with a two-digit code when something is abnormal but a failure has not occurred i.e., low signal level, etc. DIAG is displayed along with a code to indicate a failure has been detected in the VIR-32. Completion of self-test is indicated when either the normal frequency displays or a fault code is displayed on the NAV control. A partial list of diagnostic and fault codes is provided below. The codes are listed in numerical order. The **TEST** button must be pushed before any fault code can be displayed. Refer to Table 3C-2.

(11) Normal Operation. Selection procedures and display of the VHF NAV information is the same as the described for TACAN. When changing VOR frequencies, and until signal lock-on, the RMI / HSI

bearing pointers (OSA) the RMI bearing pointer (ANG) will drive to the park or 3 o'clock position and the HSI NAV warning flag will be in view. In the ILS mode, the bearing pointer(s) will remain in the park position.

Table 3C-2. Diagnostic and Fault Codes

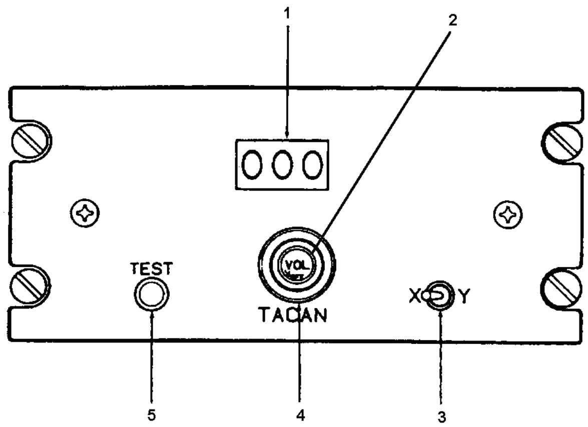
CODE	DESCRIPTION AND COMMENT	CODE	DESCRIPTION AND COMMENT
00	No fault found.	18	VOR AFC not locked. VOR unusable (no rf signal).
02	RAM test failed. Unit unusable (μP problem).	19	Low 30-Hz reference signal. VOR unusable.
03	No serial data to unit. Unit unusable (CTL problem).	20	Low 30-Hz variable signal. VOR unusable.
04	No serial frequency word. Unit unusable (CTL problem).	21	400-Hz power supply unusable. VOR OBI and OBS unusable.
05	Invalid NAV frequency. (CTL may be tuned to DME channel).	22	OBI sin out of tolerance. VOR OBI and OBS unusable.
06	Microprocessor fault. Unit unusable.	23	OBI cos out of tolerance. VOR OBS unusable.
10	Microprocessor fault. Unit unusable.	24	OBS return out of tolerance. VOR OBS unusable.
11	Analog to digital fault. Unit unusable.	25	LOC synthesizer unlocked. LOC receiver inoperative.
12	Analog to digital failed accuracy test. Unit unusable.	26	LOC signal level low. LOW unusable.
13	+13 Vdc power supply fault. Unit unusable.	27	LOC deviation out of tolerance. LOC deviation unreliable.
14	-13 Vdc power supply fault. Unit unusable.	28	GS synthesizer unlocked. GS receiver inoperative.
15	VOR sin θ/LOC digital to analog fault. VOR/LOC unusable.	29	GS signal too low. GS receiver inoperative.
16	VOR cos θ/GS digital to analog fault. VOR/GS unusable.	30	GS deviation out of tolerance. GS deviation unreliable.
17	VOR receiver synthesizer unlocked. VOR receiver inoperative.	32	Marker beacon fault. Observe marker lamps for fault.

NOTE

During ILS operation, the NAV 1 and NAV 2 deviation relays are monitored by a failure warning system. Failure of one of these relays will be indicated by the appearance of the HSI NAV and/or VERT flags.

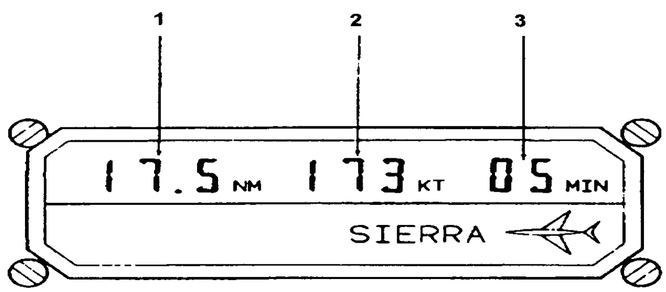
3C-22. TACAN SYSTEM.

a. Description. The TACAN system operates in conjunction with TACAN and VORTAC ground stations to provide distance, groundspeed, time-to-station, and bearing to station. Figure 3C-16 shows the TACAN control panel and Figure 3C-17 depicts the TACAN indicator. It operates in the L band 1000 MHz frequency range on one of 252 pre-selected frequencies, 126 X mode and 126 Y mode channels. Course deviation and distance to TACAN or VORTAC stations are displayed on the HSI. Distance, time-to-station, and groundspeed are displayed on the HSI. Distance, time-to-station, and groundspeed are displayed on the TACAN digital display. The groundspeed and time-to-station are accurate only if the aircraft is flying directly toward the ground station at a sufficient distance that the slant range and ground ranges are nearly equal. The system is protected by the **TACAN** circuit breaker on the avionics portion of the copilot's right sidewall panel.



1. TACAN Channel Display
2. VOL On/Off Knob
3. X/Y Switch
4. Channel Selector/Volume Control
5. TEST Push Button

Figure 3C-16. TACAN Control Panel



1. Distance To Station N.M. (Slant Range)
2. Groundspeed (KTS)
3. Time To Station (Minutes)

Figure 3C-17. TACAN Indicator

NOTE

THE TACAN portion of a VORTAC station will be read on the HSI only when the proper channel is selected on the TACAN control panel and TACAN is selected with the HSI selector switch. With VOR selected, the VIR-32 receivers are tuned to the VOR portion and the DME-42 receives the DME portion.

The TACAN system may be operated on the flight director system or connected to and used with the autopilot system. When employed as the primary means of navigation, aircraft flight may be controlled manually or by the autopilot magnetic bearing to TACAN stations may be shown on the RMI's when the **VOR ADF / TACAN ADF** push buttons, to the lower left of the pilots' RMI and to the far right of the copilot's instrument panel, are pressed to the **TACAN ADF** position. Also, the **VOR ADF** push button for the #1 (yellow) needle on the RMI's must be pressed to the **VOR** position. Course deviation only may be shown on the HSI's when the **TACAN** selector for the HSI is pressed. TACAN slant range is displayed on each HSI range in the digital distance display. TACAN distance, groundspeed, and time-to-station are all displayed on the TACAN indicator located on the copilot's instrument panel.

NOTE

Under conditions of bright direct sunlight, the VOR ADF / TACAN ADF push button indicate the selected channel.

The TACAN control panel enables selection of the TACAN frequency (channel) to be used and provides self-test of TACAN circuits. X or Y channel is selected by the **X / Y** switch. Y channels differ from X channels in frequency assignment and pulse spacing. Y channels were developed to relieve frequency congestion. Use of the Y channels has been implemented along with 0.05 MHz spacing for VOR/VORTAC stations and Y channels are paired with these new frequencies (for example, VOR frequency 113.1 is TACAN channel 78X; VOR 113.15 is TACAN channel 78Y). DoD FLIP charts will include the Y designation in the data block for Radio Aids to Navigation. The small (outer) control provides system power **ON / OFF** and station identity tone volume control. TACAN circuits are protected by a **TACAN** circuit breaker on avionics portion of the copilot's right sidewall panel.

b. Controls, Indicators, and Functions.

(1) TACAN Control Panel. Refer to Figure 3C-16.

*(a) **TACAN** Channel Display* – Indicates selected channel.

*(b) **VOL On/Off** Knob* – Provides system power and volume control.

*(c) **X / Y** Switch* – Selects either **X** or **Y** mode.

(d) Channel Selectors – Selects desired channel.

*(e) **TEST** Push Button* – When pressed, activates functional self-test.

(2) TACAN Indicator. Refer to Figure 3C-17.

(a) ***NM*** – Displays slant range distance in nautical miles from aircraft to ground station.

(b) ***KT*** – Displays groundspeed in knots.

(c) ***MIN*** – Displays time to TACAN station in minutes.

c. Normal Operating Procedures.

(1) Equipment Startup.

NOTE

It is assumed the Avionics Master Power switch is on, and that normally used avionics circuit breakers remain pressed.

1. **TACAN** control panel – Turn **VOL ON / OFF** knob **ON**.
2. **VOR ADF / TACAN ADF** Switch – Select **TACAN ADF**.
3. **RMI** Selector for #1 Needle (yellow) – Select VOR.
4. **HSI** Switches – Press **TACAN**.

(2) Self-test Procedure.

1. Course knob on **HSI** – Set 180° course.
2. TACAN control panel – Hold test switch engaged while confirming following results:

HSI course indicator centers on a 180 ± 2° TO indication. Using course knob, increase selected course. Deviation bar will move to left. Decrease selected course: deviation bar will center and move to right of center. Full-scale deflection will be 10° + 1°. In OSA aircraft, the RMI and HSI bearing pointers will indicate approximately a 180° magnetic bearing. In aircraft, only the RMI bearing pointer will indicate the 180° bearing.

(3) Normal Operation.

1. **VOR ADF / TACAN ADF** Switch – Select **TACAN ADF**.
2. **RMI** selector for #1 needle single (yellow) – Select VOR.
3. **HSI** switches – Press **TACAN**.
4. Mode switch **(X / Y)** – As required.
5. TACAN control panel – Select desired channel.
6. Wait 5 seconds for signal acquisition and lock-on. If bearing signal lock-on does not occur, the TACAN remains in the bearing search mode. If bearing lock-on is not obtained, perform an in-flight self-test to ensure correct operation of the system. Anytime the course indicator's flag is in view, in OSA aircraft, the **HSI** bearing pointer will drive to the park or 3 o'clock position. The course deviation and the TO/FROM information may be inaccurate and should be disregarded. ANG aircraft are not equipped with an HSI bearing pointer, however, the bearing, course deviation, and TO/FROM information presented may also be inaccurate and should be disregarded.

NOTE

On the RMI, there is no warning flag to indicate failure to receive the station. Instead, the RMI needle will drive to the park or 3 o'clock position. Always crosscheck the RMI with the HSI course indicator for a possible warning flag.

7. Ensure that audio station identification signal is correct for the ground station selected.
8. Course Knob (HSI) – Set course desired. Verify proper **TO** or **FROM** pointer indication. Intercept course as required. In OSA aircraft, verify intercept heading by reference to the RMI and HSI bearing pointers. In ANG aircraft, verify intercept heading by reference to RMI using RMI only procedures.
9. Course Deviation Bar (**HSI**) – Read deviation from selected course. The difference between the aircraft's heading and the course pointer, when the course deviation bar is centered and the aircraft is tracking the selected course, will show the wind correction angle.

10. TACAN Indicator – Read range (NM). Verify proper range is represented on HSI distance readout.

11. If desired to proceed direct TO or FROM a TACAN station, or determine the course, rotate the course knob until the course deviation bar is centered and the TO/FROM pointer indicates TO or FROM.

NOTE

Always crosscheck the HSI with the RMI and other available navaids to determine position.

12. To use TACAN with pilot-controlled flight, control aircraft by manual controls, responding to information displayed on the flight director, RMI, HSI, and other instruments.

13. To use TACAN with the autopilot, press **AP ENGAGE** and monitor autopilot performance on flight director, RMI, and TACAN indicators. Verify adherence to preset heading and course and confirm the execution of displayed steering commands.

NOTE

The TACAN groundspeed reading will be accurate only when the aircraft is on a course directly to or from the TACAN station. When headed away from the station, the TACAN indicator minutes reading will be in error.

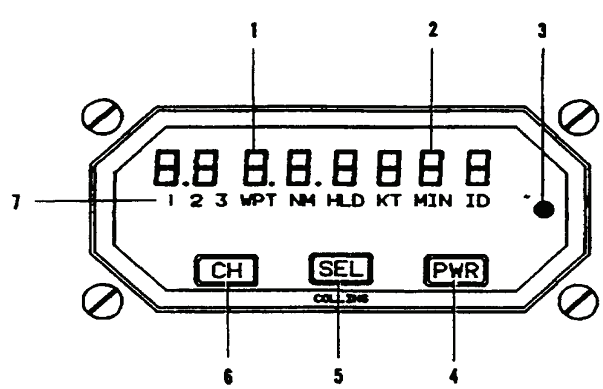
(4) Shutdown. Turn **VOL / ON / OFF** knob – **OFF**.

3C-23. DISTANCE MEASURING EQUIPMENT (DME).

a. Introduction. The DME-42 receiver/ transmitter and IND-42A indicator can simultaneously track and provide complete information from up to three DME stations. The information displayed on the IND-42A includes channel number (1, 2, or 3), distance, groundspeed, time-to/from-station, and the station identifier including the identifier of a DME co-located with an ILS. Refer to Figure 3C-18.

Three-channel operation will have the DME-42 being controlled by both CTL-32 NAV Controls. These provide serial digital commands to operate on 1, 2, or 3 specific frequencies through the single input port of the DME-42. The DME channel 1 frequency will always be the same as shown by the active frequency display on the pilot's side CTL-32. The DME channel 2 frequency will always be the same as shown by the active frequency display on the copilot's side CTL-32. The channel 3 frequency is the same as shown by the preset frequency display on the pilot's side CTL-32.

b. Controls, Indicators, and Functions. Except for audio, frequency selection and the self-test switch, all operating controls for the DME system are located on the IND-42A Indicator. Frequency selection is accomplished using the CTL-32 NAV Control. The DME-42 self-test routine can be initiated using the **TEST** button on the CTL-32. DME audio is only available for channels 1 and 2. When the **DME** audio selector switch (pilot/copilot), located on the audio control panel, is in the up position, DME audio is available from either DME channel 1 or 2 as selected by the **DME AUDIO CHAN 1** / **CHAN 2** toggle switch located below the Data NAV control unit. Refer to Figure 3C-18.



1. **Numeric Display**
2. **Alphanumeric Display**
3. **Light Sensor**
4. **PWR Switch**
5. **Mode SEL Switch**
6. **CH (channel) Switch**
7. **Annunciators**

Figure 3C-18. IND-42A DME Indicator

(1) Numeric Display – The numeric display presents the **NM** (distance) and diagnostic code.

(2) Alphanumeric Display – The alphanumeric display presents the **KT** (Velocity) time-to-station **ID** (2, 3, or 4 letter station identifier), and diagnostic identifier.

(3) Light Sensor – The built-in light sensor automatically controls the display brightness.

(4) Power Switch – The latching push-on/push-off **PWR** switch controls the power applied to the IND-42A indicator.

(5) Mode Selector Switch – The non-latching push-button **SEL** switch selects the information to be displayed in the display. (When power is initially applied, **NM** (distance) is shown in the numeric display and **ID** (DME station identifier) is shown in the alphanumeric display). Pressing the **SEL** switch will sequentially select **KT** (velocity), **MIN** (time-to-station), and **ID** (2, 3, or 4 letter station identifier). **KT**, **MIN**, and **ID** are shown in the alphanumeric display and **NM** is continuously shown in the numeric display.

(6) Channel Switch – The momentary push-button **CH** switch sequentially selects the information from the next DME channel and lights the appropriate channel annunciator 1, 2 (or 3 if enabled).

(7) Annunciators – The annunciators provide an indication of which DME channel is selected, system operational information, and units of measure. The following list describes the annunciators.

(a) ***1, 2, 3*** – Sequentially controlled by the **CH** button to indicate which DME channel is providing the information being displayed in the numeric and alphanumeric displays.

(b) ***WPT*** – Not used.

(c) ***NM*** – Automatically illuminates after power on when valid DME data is available. Indicates that the numbers displayed in the numeric display are slant range DME distance in nautical miles.

(d) ***HLD*** – Indicates that DME hold has been selected on the CTL-32 NAV Control.

(e) ***KT*** – Sequentially controlled by the **SEL** button and indicates that the numbers displayed in the alphanumeric display are the computed groundspeed in knots. Groundspeed is based on rate of change of DME distance and accurately reflects slant-range speed only when the aircraft is flying directly to or from the station.

(f) ***MIN*** – Sequentially controlled by the **SEL** button and indicates that the numbers displayed in the alphanumeric display are the computed time-to-station in minutes. Like the groundspeed (**KT**) display, time-to-go is also based on rate of change of DME distance.

(g) ***ID*** – Automatically illuminates after power on. The DME ident is transmitted once every 30 seconds and it is possible that 2 minutes could elapse before the station ident is displayed in the alphanumeric display. The station identifier is usually 3 letters, but can be 2, 3, or 4 letters, depending on the facility being used.

CAUTION

It is not practical to provide monitoring for all conceivable system failures and, however unlikely, it is possible that erroneous operation could occur without a fault indication. It is the responsibility of the pilot to detect such an occurrence by means of crosschecks with redundant or correlated information available in the cockpit.

c. Operating Procedures.

(1) Equipment Turn On – Apply power by pressing the **PWR** button on the IND 42A. The **NM** and **ID** annunciators and the channel 1 or 2 annunciator will be illuminated. If the DME-42 is within range of the selected station, the numeric display will show the slant range distance, and after two DME idents have been received and processed, the alphanumeric display will show the 2, 3, or 4 letter station identifier.

CAUTION

The DME-42 may not decode the identity transmissions correctly, it is the responsibility of the pilot to verify reception of the intended ground station through the audio identifier as necessary.

(2) Frequency Selection – The NAV frequency for DME channel 1 is the frequency shown in the active frequency display of the pilot's CTL-32. The frequency can be changed using the **ACT** button or the **XFR / MEM** switch. DME channel 2 is the frequency shown in the active frequency display of the copilot’s CTL-32, and DME channel 3 is the frequency shown in the preset frequency display of the pilot's CTL-32.

Using the pilot's and copilot's active and the pilot's preset displays, select the desired VORTAC or ILS frequency for paired DME channels, or the VHF NAV frequency for unpaired channels. The DME channel that is associated with the VORTAC, ILS, or unpaired VHF NAV frequency is automatically selected.

Table 3C-3 lists the VHF NAV frequencies and corresponding DME channels. The frequency is listed across the top and down the left side of the table. This frequency matrix is used to determine the DME channel. For example, ILS-LOC frequency 108.30 MHz is DME channel 20, VOR frequency 114.70 MHz channel 94, etc. DME channels 1 through 126 listed in the table are the DME X channels. The DME Y channels can be determined from the table by adding 0.05 MHz to each of the 0. 1-MHz columns. For example, ILS-LOC frequency 108.35 MHz is DME channel 20Y, VOR frequency E 114.75 MHz is DME channel 94Y, etc. The 126X channels and 126Y channels total the 252 DME channels available.

Table 3C-3. VHF Frequencies Versus DME X Channels

VHF NAV (CTL-32)	0.1 MHz									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
134	---	---	---	---	1	2	3	5	6	
135	7	8	9	10	11	12	13	15	16	
	Unpaired channels									
108	17	18	19	20	21	22	23	24	25	26
109	27	28	29	30	31	32	33	34	35	36
110	37	38	39	40	41	42	43	44	45	46
111	47	48	49	50	51	52	53	54	55	56
112	57	58	59	---	---	---	---	---	---	---
	Even-numbered channels paired with ILS localizer									
	Odd-numbered channels paired with VOR									
133	---	---	---	60	61	62	63	64	65	66
134	67	68	69	---	---	---	---	---	---	---
	Unpaired channels									
112	---	---	---	70	71	72	73	74	75	76
113	77	78	79	80	81	82	83	84	85	86
114	87	88	89	90	91	92	93	94	95	96
115	97	98	99	100	101	102	103	104	105	106
116	107	108	109	110	111	112	113	114	115	116
117	117	118	119	120	121	122	123	124	125	126
	Channels paired with VOR.									
NOTE: The unpaired channels (1-16 and 60-69) cannot be received.										

(3) Channel Selection. After the three VHF NAV frequencies are tuned, DME information from any of the three can be displayed on the IND-42A by sequentially pressing the **CH** button to call up T, 2, or 3. If one of the three channels has invalid data, dashes will be displayed.

When DME data is valid, sequentially pressing the **CH** button on the IND-42A will display the **NM** and **ID** for each of the three channels.

(4) Normal Operation.

(a) Select the three desired NAV frequencies as previously described. Use the **CH** button on the IND-42A to select the desired channel for display (1, 2, or 3). The numeric display will show the slant range distance from 0 to 300 nm. The distance is accurate to 0.1 nm and the display will show tenths of a mile from 0 to 199.9 nm, and 1-mile increments from 200 to 300 nm. The **NM** and **ID** annunciators will be illuminated and the alphanumeric display will show the station identifier. A 10 to 14 second memory in the DME-42 prevents dashes from being displayed if the received – signal is temporarily lost or weak.

NOTE

The maximum range of the DME-42 is 300 nm. The range capability of a DME is limited by aircraft altitude, obstructions such as hills or mountains, and the curvature of the earth.

DME slant range is the straight-line distance from the aircraft to the ground

station. Ground range from the station can be computed by using altitude and slant range. The difference between slant range and ground range is usually insignificant except when flying over the selected ground station. For example, an aircraft that is 100 nm ground range from a station and flying at 35,000 feet altitude is approximately 100.17 nm slant range from the ground station. When flying directly over the ground station, the DME distance information is the aircraft altitude in nautical miles above the station.

(b) Press the **SEL** button on the IND-42A until **KT** is annunciated. The alphanumeric display now shows computed groundspeed in knots if the computed groundspeed is between 50 and 999 knots. Accuracy of the display is +1 knot or +1%, whichever is greater, and will be true only after 30 to 60 seconds. Dashes will be shown in the alphanumeric display if the computed groundspeed is less than 50 knots.

(c) Press the **SEL** button on the IND-42A until **MIN** is annunciated. The alphanumeric display now shows the time in minutes to or from the station if the computed groundspeed is greater than 50 knots. Dashes will be shown in the alphanumeric display if the computed groundspeed is less than 50 knots. The **MIN** display ranges from 0 to 120 minutes. Accuracy of the display is +1 minute.

NOTE

The KT and MIN indications are accurate only if the aircraft is tracking directly toward or away from the ground station and the distance is sufficient for the slant range and ground range to be nearly equal. For example, at an altitude of 12,000 feet above the VORTAC station and at a slant range of 10 nm from the station, the groundspeed indication is lower than actual aircraft groundspeed by approximately 2%. The MIN indication will have a corresponding error.

If the DME is put into hold, the ID display will automatically be selected when the HLD annunciator illuminates. The pilot may still select other modes (KT, MIN), but when he stops pushing the SEL button, the display will revert to the ID mode after approximately 5 seconds. This is a safety feature to remind the pilot not only that the DME is in hold, but also to show which station is being held.

DME hold is not functional for the third DME channel (#1 NAV pre-select). Therefore, this safety feature is not applicable.

When the #1 NAV is in the hold mode, the pre-selected frequency (channeling DME #3) remains active although not displayed.

(5) Self-Test. An extensive self-test diagnostic routine can be initiated in the DME-42 by pushing the **TEST** button on the CTL-32 NAV Control. The self-test routine takes approximately 10 seconds to complete. After initiating self-test, all display segments and annunciators on the IND-42A illuminate for a lamp test. If **NM** and **ID** were being displayed, the numeric display will show a test distance of 100 **NM**. The alphanumeric display will show AOIC at the completion of the test routine if no faults have been detected. The DME aural output will be the Morse characters AOK. If **KT** was being displayed, the alphanumeric display will show a test groundspeed of 100 **KT**. If **MIN** was being displayed, the alphanumeric display will show a test time of 60 **MIN**. Completion of self-test is indicated when either the IND-42A displays return to normal or the word DIAG along with a self-test fault code is displayed on the IND 42A. Tables 3C-4 and 3C-5 provide a partial list of diagnostic and fault codes.

NOTE

Due to the approximate 10-second self-test cycle time, the test should be made as a preflight check and not during critical flight times.

Table 3C-4. DME-42 Diagnostics

CODE	DESCRIPTION
01	Power supply
02	Synthesizer
03	Transmitter
04	Video processor
05	Receiver
06	Distance processor
07	Microprocessor ROM
08	Microprocessor RAM

Table 3C-5. IND-42 Diagnostics

CODE	’TION
90	Bus failure (no data)
91	TEST mode failure (no response)
92	Distance word missing
93	VEL, TTS word missing

Table 3C-5. IND-42 Diagnostics

CODE	DESCRIPTION
94	IDENT word missing
95	Microprocessor RAM
96	Microprocessor ROM

3C-24. AUTOMATIC DIRECTION FINDER (ADF).

a. Description. The ADF-60 system provides aural reception of signals from a selected ground station and indicates relative bearing to that station. The ground station must be within the frequency range of 190 to 1749.5 kHz. The ADF-60 system has three functional modes of operation. In **ANT** mode, the ADF receiver functions as an aural receiver, providing only an aural output of the received signal. In **ADF** mode, it functions as an automatic direction finder receiver in which relative bearing-to-the-station is presented on HSI, and an aural output of the received signal is provided. A **TONE** mode provides a 1000-Hz aural output tone, when a signal is being received, to identify keyed CW signals.

b. Operating Controls and Functions. All operating controls for the ADF-60 system are located on the CTL-62 ADF Control. Refer to Figure 3C-19.

(1) Compare Annunciator. **ACT** momentarily illuminates when frequencies are being changed. **ACT** flashes if the actual radio frequency is not identical to the frequency shown in the active frequency display.

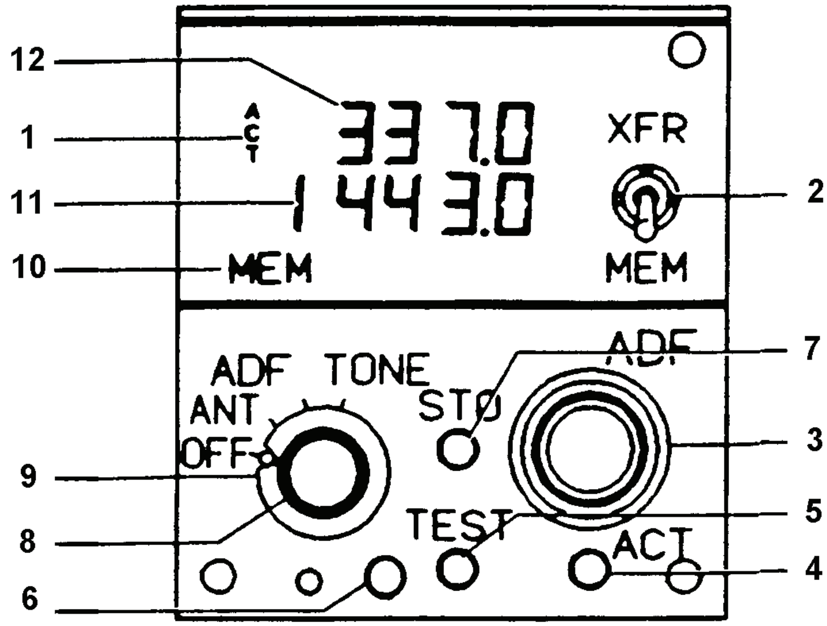
*(2) **XFR** / **MEM** Switch*. This switch is a 3-position, spring-loaded toggle switch. When held to the **XFR** position, the preset frequency is transferred up to the active display and the ADF-60 retunes. The previously active frequency becomes the new preset frequency and is displayed in the lower window. When this switch is held to the **MEM** position, one of the four stacked memory frequencies is loaded into the preset display. Successive pushes cycle the four memory frequencies through the display (…2, 3, 4, 1, 2, 3…).

(3) Frequency Select Knob. Two concentric knobs control the preset or active frequency displays. The larger knob changes the 1000's and 100's kHz digits. The smaller knob changes the 10's, units, and tenths kHz digits. Each detent of the larger knob changes the frequency in 100-kHz steps. Each detent of the smaller knob change the frequency in 1-kHz steps with the exception that the first two detent positions following a change in rotational direction will cause a 0.5-kHz change. Rapid rotation of the smaller knob will cause frequency changes greater than 1 kHz as a function of the rate of rotation. Frequencies roll over at the upper and lower limits. The two frequency select switches are independent of each other such that the upper and lower limit rollover of the 10-kHz digit will not cause the 100-kHz digit to change.

*(4) **ACT** Button*. Push the **ACT** button for approximately 2 seconds to enable the frequency select knobs to directly retune the ADF-60. The bottom window will display dashes and the upper window will continue to display the active frequency. Push the **ACT** button a second time to return the control to the normal 2-display mode.

*(5) **TEST** Button*. Press the **TEST** button to initiate the radio self-test routine. (Self-test is active only when the **TEST** button is pressed.)

(6) Light Sensor. The built-in light sensor automatically controls the display brightness.



1. Compare Annunciator (ACT)
2. XFR/MEM Switch
3. Frequency Select Knobs
4. ACT Button
5. TEST Button
6. Light Sensor
7. STO Button
8. Volume Control
9. Power and Mode Switch
10. Annunciators (MEM, HLD)
11. Preset Frequency Display
12. Active Frequency Display

Figure 3C-19. ADF Control

*(7) **STO** Button.* The **STO** button allows up to four preset frequencies to be selected and entered into the control's memory. After presetting the frequency to be stored, push the **STO** button. The upper window displays the channel number of available memory (CH 1 through CH 4); the lower window continues to display the frequency to be stored. For approximately 5 seconds, the **MEM** switch may be used to advance through the channel numbers without changing the preset display. Push the **STO** button a second time to commit the preset frequency to memory in the selected location. After approximately 5 seconds, the control will return to normal operation.

(8) Volume Control. A volume control is concentric with the power and mode switch.

(9) Power and Mode Switch. The power and mode switch contains four detented positions. The **OFF** position removes system power. Selecting **ANT**, **ADF**, or **TONE** applies power to the ADF system and establishes the system mode of operation.

(10) Annunciators. Displays annunciator fields.

(11) Preset Frequency Display. The preset (inactive) frequency and diagnostic messages are displayed in the lower window.

(12) Active Frequency Display. The active frequency (frequency to which the ADF-60 is tuned) and diagnostic messages are displayed in the upper window.

c. Operating Procedures.

CAUTION

It is not practical to provide monitoring for all conceivable system failures and, however unlikely, it is possible that erroneous operation could occur without a fault indication. It is the responsibility of the pilot to detect such an occurrence by means of cross-checks with redundant or correlated information available in the cockpit.

(1) Equipment Turn On. The ADF-60 receiver and the CTL-62 ADF control are turned on by rotating the power and mode switch on the ADF control to the **ANT**, **ADF**, or **TONE** position.

After power is applied, the CTL-62 displays the same active and preset frequencies that were preset when the equipment was last turned off.

(2) Frequency Selection. Frequency selection is made using either the frequency select knobs, the **XFR / MEM** (transfer/memory recall switch).

For future developments, the CTL-62 has a normal frequency range of 190.00 to 1799.5 kHz. However, when used with the ADF-60, the upper frequency is limited to 1749.5 kHz. Rotation of either frequency select knob increases or decreases the frequency in the preset frequency display. The larger outer knob changes the frequency in 1000- and 100-kHz increments (first and second numbers from the left). The smaller inner knob changes the frequency in 10's, units, and tenths kHz increments (third, fourth, and fifth numbers from the left).

After the desired frequency is set in the preset frequency display, it can be transferred to the active frequency display by momentarily setting the **XFR / MEM** switch **XFR**. At the same time that the preset frequency is transferred to the active display, the previously active frequency is transferred to the preset display. The **ACT** annunciator on the control flashes while the receiver is tuning to the new frequency.

NOTE

If the ACT annunciator continues flashing, it indicates that the receiver is not tuned to the frequency displayed in the active display.

The CTL-62 has a memory that permits storing up to four preset frequencies. Once stored, these frequencies can be recalled to the preset display by positioning the **XFR / MEM** switch to the **MEM** position. The storage location (CH 1 through CH 4) for the recalled frequency is displayed in the active frequency display while the **XFR / MEM** switch is held in the **MEM** position. All four stored frequencies can be displayed one at a time in the preset display by repeatedly positioning the **XFR / MEM** switch to the **MEM** position. After the desired stored frequency has been recalled to the preset display, it can be transferred to the active display by momentarily positioning the **XFR / MEM** switch to the **XFR** position.

During normal operation, all frequency selections and revisions are done in the preset frequency display. However, the active frequency can be selected directly, as described in the following paragraph.

(3) Direct Active Frequency Selection. The active frequency can be selected directly with the frequency select knobs by pushing the **ACT** button for about 2 seconds. The active frequency selection mode is indicated by dashes appearing in the preset display. Also, the **ACT** annunciator will flash as the frequency select knobs are turned to indicate that the transceiver is being re-tuned.

NOTE

If the ACT annunciator continues flashing after the frequency has been selected, it indicates that the receiver is not tuned to the frequency displayed in the active display.

To return to the preset frequency selection mode, merely push the **ACT** button again for about 2 seconds.

As a safety feature, the CTL-62 automatically switches to the active frequency selection mode when a frequency select knob is operated while the **STO**, **TEST**, or **XFR / MEM** switches are actuated, or the memory recall inputs to the control are grounded.

(4) Frequency Storage. Up to four preset frequencies can be stored in the memory in the CTL-62 for future recall. To program the memory, select the frequency in the preset frequency display using the frequency select knob and push the **STO** button once. One of the channel numbers (CH 1 through CH 4) will appear in the active display for approximately 5 seconds. During this time, the channel number can be changed without changing the preset frequency by momentarily positioning the **XFR / MEM** switch to the **MEM** position. After the desired channel number has been selected, push the **STO** button again to store the frequency.

NOTE

When storing a frequency, the second actuation of the STO button must be done within 5 seconds after selecting the channel number or the first actuation of the STO button. If more than 5 seconds elapse, the control will revert to the normal modes of operation and the second store command will be interpreted as the first store command.

After a frequency has been stored in memory, it will remain there until changed by using the **STO** button. Memory is retained even when the unit is turned off for an extended period of time.

d. Normal Operation.

(1) Function Selection. Position the power and mode switch to **ANT**, **ADF**, or **TONE** (**BFO**).

(2) Frequency Selection. Using the preceding frequency select procedures, tune the ADF until the desired frequency is indicated in the active frequency display and verify the station identifier.

(a) ANT Function. Position the power and mode switch to **ANT**. The **RMI** pointer will park horizontally. Select **ADF** on the audio system and adjust the volume.

(b) ADF Function. Position the power and mode switch to **ADF**. The **RMI** pointer will indicate relative bearing to the turned station.

NOTE

When the ADF system is not receiving a reliable signal, the RMI pointer will remain parked in the ADF mode. The ADF may momentarily park during station crossings because of signal loss. If the bearing pointer fails to respond as indicated or ID is lost in ANT position, the ADF should be considered unreliable and will not be used for navigation or approaches.

(c) ***TONE*** *Function*. Position the power and mode switch to **TONE** (BFO). A 1000-Hz tone will identify keyed CW stations.

e. Self-Test.

NOTE

If the signal received is weak or of poor quality, the bearing pointer rotation will be slow.

1. Position the power and mode switch to **ADF** and tune a nearby NDB, outer marker, or broadcast station and press the **TEST** button. The **RMI** pointer will rotate 90° from the previous valid indication.

2. Release the **TEST** button and verify that the **RMI** pointer returns to that indication. Select **ANT** on the ADF control panel. Bearing pointer should point horizontally, and a valid aural navaid identifier (ID) should continue.

3. Select **ADF** on the control panel. The bearing pointer should return to the proper relative bearing.

3C-25. RADIO MAGNETIC INDICATOR.

Two identical Radio Magnetic Indicators (RMI's) are installed, one on each side of the instrument panel. Each RMI provides aircraft heading and radio bearing information TO/FROM a VOR, TACAN, or ADF facility. A selector switch on the RMI allows the operator to select either **ADF** and **#1 VOR** or **ADF** and **TACAN** for single needle display. The double needle always points to the ADF or #2 VOR bearing as selected by the double needle switch.

NOTE

Aircraft RMI circuitry modified by Beech Service Instruction No. C-12-0118, will operate as follows: In addition to the standard warning flag conditions, if a TACAN circuitry 26 Vac electrical power loss occurs and TACAN is selected, the RMI single-needle pointer will drive to the three o'clock PARK position.

3C-26. GLOBAL POSITIONING SYSTEM (KLN 90B).

Refer to Chapter 3D for detailed information.

3C-27. ALTIMETERS.

a. Pilot's Servoed Altimeter.

(1) General. The pilot's altimeter provides a servoed counter drum/pointer display of barometrically corrected pressure altitude, derived from the air data computer system. For proper operation, the 2-ampere **AIR DATA ENCODER** circuit breaker located in the avionics section of the right sidewall circuit breaker panel must be set. The altimeter is 26 Vac powered, and is protected by the 12-ampere **PILOT ALTM** circuit breaker also located on the right wall panel.

(2) Displays. The servoed altimeter provides the following displays:

1. Counter drum display of altitude, in 20-foot increments.

2. Pointer display of altitude between 1000-foot levels in 20-foot graduations.

3. Altitudes below 10,000 feet are annunciated by a black and white crosshatch on the left digit position of the counter display.

(3) Barometric Pressure Counter. A barometric pressure counter, manually set by the BARO knob, displays barometric pressure in inches of mercury (Hg.), and millibars (Mb.), and provides this information to the air data computer. A red warning flag in view indicates the altitude information is unreliable, however the Mode C (altitude reporting) information may be valid.

WARNING

In the event of a total aircraft ac and dc electrical power loss, the warning flag will be in view, the altimeter will be inoperative, and the indicated altitude will remain as existed at the time of failure. A dc power loss only (retains ac power) usually results in the altimeter spooling down toward a lower altitude instead of retaining the altitude at which the power failure occurred.

(4) Altitude Alert Annunicator. The Altitude Alert Annunciator (**ALT**), located on the upper bezel, illuminates to provide a visual indication of when the aircraft is within 1000 feet of the pre-selected altitude during the capture maneuver and extinguishes as the aircraft is within 300 ± 50 feet of the pre-selected altitude. After capture, the light will re-illuminate if the aircraft departs more than 300 ± 50 feet from the selected altitude, and extinguish when the aircraft has departed more than 1000 feet from the selected altitude.

b. Copilot's Pneumatic Altimeter. The copilot's altimeter is a pneumatic instrument equipped with a 28 Vdc internal vibrator. The vibrator is required to overcome friction and assure instrument accuracy. Altitude is displayed on the altimeter by 10,000, 1,000 and 100-foot counter drums, and a single-needle pointer that indicates hundreds of feet in 20-foot increments. The barometric pressure setting knob is provided to simultaneously adjust the baro counters display in inches of mercury (Hg.), and millibars (Mb.). Below an altitude of 10,000 feet, a diagonal symbol will appear in the 10,000-foot counter. A circuit breaker, placarded **COPILOT ALTM**, located in the flight group on the right side circuit breaker panel protects the vibrator circuit.

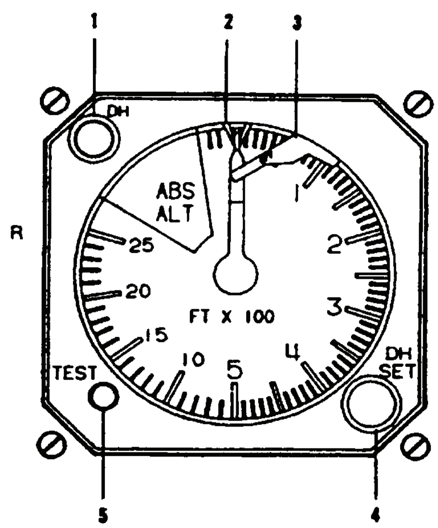
3C-28. RADIO ALTIMETER INDICATOR.

a. General. Displays radio altitude information from 2500 feet to touchdown with an expanded linear scale under 500 feet.

b. Controls, Indicators, and Functions. Refer to Figure 3C-20.

(1) Decision Height Annunciator – Lights to alert that aircraft is at or below selected DH.

(2) Decision Height Bug – Triangular decision height bug is manually set by knob.



1. **DH (Decision Height) Annunciator**
2. **Decision Height Bug**
3. **Failure Warning Flag**
4. **DH (Decision Height) SET Knob**
5. **TEST Push Button**

Figure 3C-20. Radio Altimeter

(3) Failure Warning Flag – A failure warning flag in view indicates the system information may be unreliable.

(4) Decision Height Set Knob – Sets the radio altimeter decision height marker to a decision height altitude.

*(5) **TEST** Button* – **TEST** button checks indicator R/T unit and flag operation.

c. Normal Operation.

(1) Setting Decision Height Altitude. The radio altimeter also provides altitude and decision height information to the GCAS. Set the decision height altitude using the decision height set knob. Setting the radio altimeter decision height marker to a decision height altitude will cause the GCAS to announce the "Minimums, Minimums" aural warning when the aircraft transitions through the selected DH altitude.

(2) Testing. Operating the **TEST** button causes the flag to come into view and altitude pointer to indicate approximately 100 feet. Release of button causes pointer to return to existing altitude and flag to retract.

3C-29. VERTICAL SPEED INDICATORS.

The vertical speed indicators are mounted on both sides of the instrument panel. The face is placarded **VERTICAL SPEED**, **UP**, and **DOWN**. The range of the instrument is from 0 to 4000 feet per minute, with the first 2000 feet graduated in 100-foot per minute increments and the remainder in 250-foot per minute increments.

3C-30. TURN AND SLIP INDICATOR.

Refer to Chapter 2, Paragraph 2-77 for detailed information.

3C-31. GYRO MAGNETIC COMPASS SYSTEM.

a. Description. Two identical compass systems provide accurate directional information for the aircraft at all latitudes of the earth. For heading reference, two modes of operation are used: directional gyro (FREE) mode, or slaved (SLAVE) mode.

b. Operation. In areas where magnetic references are reliable, the system is operated in the SLAVE mode. In this mode, the directional gyro is slaved to the magnetic flux valve that supplies magnetic reference for correction of the apparent drift of the gyro. In FREE mode, the system is operated as a free gyro. In this mode, latitude corrections are manually introduced using the **INCREASE / DECREASE** switches located outboard of each HSI. The slave/free mode is selected as desired using the **SLAVE / FREE** switches also located outboard of each HSI. Both compass systems (No. 1 and No. 2) are ac power dependent and are powered by the selected inverter.

Gyro compass 1 provides heading information for the pilot's HSI and copilot's RMI. Gyro compass 2 serves the copilot's HSI and the pilot's RMI.

c. Compass Synchronization Annunciator. Consists of the symbol ▯ or **X** (dot or cross) displayed in a window. When the compass system is in the slaved mode, the display will oscillate between the ▯ and **X**, indicating the heading dial is synchronized with gyro stabilized magnetic heading.

3C-32. VERTICAL GYRO SYSTEM.

The pilot's and copilot's vertical gyro systems are independent and powered by the ac power bus located in the nose avionics compartment. The purpose of the vertical gyro systems is to provide the pilots with visual indications of aircraft pitch and roll attitudes on the flight director indicators. The gyroscope develops through synchros, pitch, and roll signals representative of the aircraft attitude. Vertical reference is established by two gravity sensitive switches, which control a torque motor for each gyro axis. High or low erection rate of the gyro is accomplished by applying high or low voltage to the respective torque motor. Panel mounted switches, placarded **NO. 1** (pilot) and **NO. 2** (copilot) **V GYRO FAST ERECT,** provide the means for fast erection of the gyros. Pressing the **FAST ERECT** switch will erect the gyro to within 1.0° of pitch and roll within 60 seconds of power application, and erect to within 0.5° within 2 minutes.

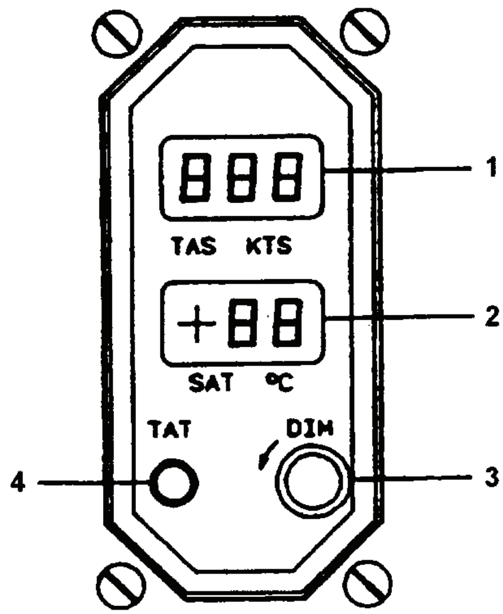
3C-33. TOTAL AIRSPEED / TEMPERATURE INDICATOR.

a. Description. The combined Total Airspeed, Static Air Temperature indicator provides a digital display of both TAS and SAT or TAT as generated by the air data computer.

b. Display. The input signals are displayed as follows. Refer to Figure 3C-21.

*(1) **TAS*** – Displays TAS.

*(2) **SAT*** – Displays SAT in two digits and the ± sign from -99° to + 50° C.



1. True Airspeed Indicator
2. Static/True Air Temperature Indicator
3. Front Panel Dimming Control
4. True Air Temperature Push Button

Figure 3C-21. True Airspeed/Static/True Air Temperature/True Air Temperature Indicator

(3) ***DIM*** *Knob* – Front panel-dimming control.

(4) ***TAT*** *Button* – Momentary push button when pressed changes SAT to TAT.

Section IV. RADAR AND TRANSPONDER

3C-34. RADAR SYSTEM.

a. Description. The Honeywell Primus 300SL color radar system is a lightweight, X-band digital radar with alphanumerics designed for weather detection and analysis and ground mapping.

The primary purpose of the system is to detect storms along the flight path and give the pilot a visual indication in color of the rainfall intensity. After proper evaluation, the pilot can chart a course to avoid these storm areas.

WARNING

The system performs only the function of weather detection or ground mapping. It should not be used, nor relied upon, for proximity warning or anticollision protection.

CAUTION

Do not operate radar system, even in STANDBY Mode, without 115-Vac, 400-Hz power applied to the system.

Without ac power, the receiver-transmitter-cooling blower will not operate, which could result in circuit damage and/or automatic shutdown.

In weather detection mode, storm intensity levels are displayed in three bright colors contrasted against a deep black background. Areas of heaviest rainfall will appear in red, less severe rainfall in yellow, moderate rainfall in green, and little or no rainfall in black (background).

Range marks and identifying numerics, displayed in cyan, are provided to facilitate evaluation of storm cells. The cyclic function further emphasizes the heavy rainfall areas (red) of the weather display by flashing them approximately once per second.

Selection of the map function causes system parameters to be optimized on the three lowest ranges to improve resolution and identification of small forgets at short ranges. The reflected signal from various ground surfaces is displayed as magenta, yellow, or cyan (most to least reflective).

The radar system consists of three units: indicator, receiver/transmitter, and antenna. The indicator is mounted in the cockpit and contains all the controls used to operate the radar. The receiver/transmitter is located on the radio rack. The antenna, which is fully stabilized for aircraft pitch and roll, is in the avionics compartment in the nose of the aircraft.

b. Controls, Indicators, and Functions. Refer to Figure 3C-22.

*(1) **INT / OFF**.* Rotary control used to turn system on and off, and to adjust (intensity) of display. STARTUP, STBY, and 100 will be displayed.

(2) Display Area. Displays visual indication, in color, of rainfall intensity with range marks and identifying numerics.

(a) Mode Field. Selected function is displayed as STBY, WX, CYC, MAP, or TEST. WAIT is displayed until the initial RT warm-up period has expired and the Indicator and Antenna are synchronized.

(b) Auxiliary Field. Color bar relates displayed colors to signal reflectivity levels 1, 2, and 3 displayed beneath color bar.

1 For WX, CYC, and TEST, color bar is green, yellow, and red. For MAP, color bar is cyan, yellow, and magenta.

2 VAR replaces 1, 2, 3 in WX and MAP when **GAIN** control is not in detented **PRESET** position.

3 FRZ is displayed as a blinking word when freeze function is selected.

(c) Target Field. Blank unless target alert is enabled causing letter T in red rectangle to be displayed. Flashing alert symbol TGT ↑ in a red rectangle is displayed when red-level target is detected within the target alert sector.

(d) Range Mark Numerics. Five labeled range marks are displayed on each range. The fifth range mark label is larger serving to identify the selected range. Range and azimuth marks and numerics are displayed in cyan for WX, CYC, and TEST; in green for MAP.

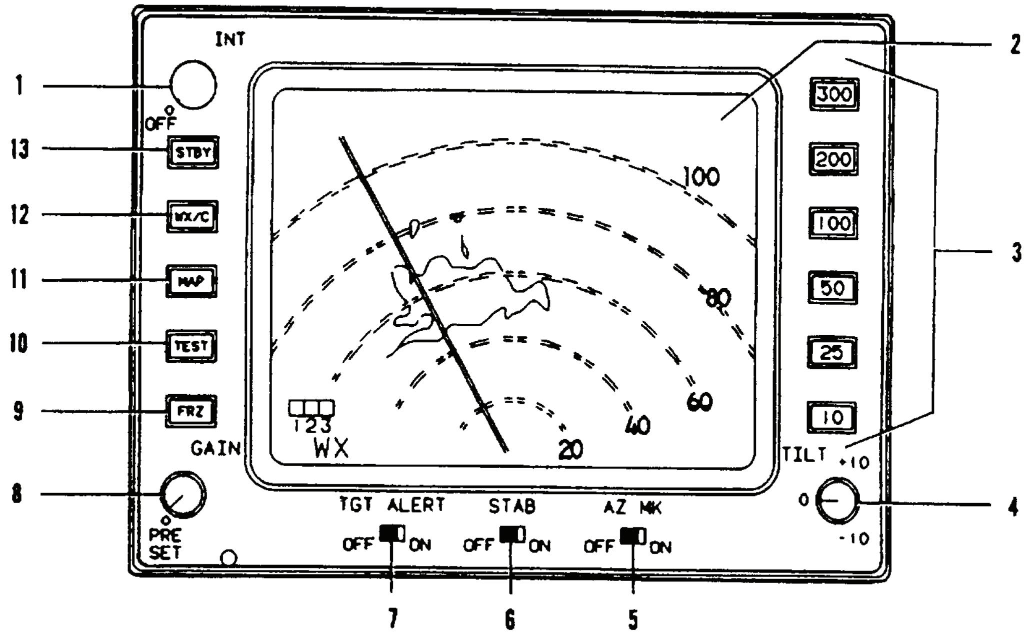
(3) ***10 / 25 / 50 / 100 / 200 / 300***. Momentary push buttons used to select one of six ranges. For each selected range, five range marks are displayed. At system startup, 100-mile range is automatically selected. Internal memory for range push buttons is always active.

*(4) **TILT**.* Rotary control used to select tilt angle of antenna beam with relation to earth (with stabilization on) or with relation to airframe (with stabilization off). Clockwise rotation tilts beam upward 0 to 10°; counterclockwise rotation tilts beam downward 0 to 10°.

*(5) **AZ MK**.* Slide control used to either display or not display azimuth markers at 30° intervals.

(6) ***STAB***. Slide control used to turn antenna stabilization on or off.

(7) ***TGT ALRT***. Slide control used to turn target alert function on or off. When enabled, letter T in red rectangle is displayed to identify that target alert function is active. Target alert is active only when radar gain is calibrated; i.e., in WX with GAIN PRESET and in CYC or TEST. The symbol TGT ↑ in a red rectangle is displayed and flashes once each second whenever a red-level target is detected within the target alert section (range from 60 to 160 nm and within ± 7.5° of aircraft heading). Target alert is deactivated automatically if MAP is selected or if variable GAIN is used, but is reactivated automatically when operating controls are restored to valid alert settings.



1. **INT OFF**
2. **Display Area**
3. **10 25 50 100 200 300**
4. **TILT**
5. **AZ MK**
6. **STAB**
7. **TGT ALERT**
8. **GAIN**
9. **FRZ**
10. **TEST**
11. **MAP**
12. **WX/C**
13. **STBY**

Figure 3C-22. Color Weather Radar

(8) ***GAIN***. Rotary control with one fixed-gain detented position **PRESET**. Used to adjust sensitivity of radar receiver, primarily to resolve nearby strong target signals while ground mapping. Sensitivity increases with clockwise rotation. Full counter-clockwise rotation to detent sets gain at preset level. When control is not in detented position, VAR is displayed unless preset gain has been automatically selected.

(9) ***FRZ***. Momentary push button used to turn freeze function on or off with alternate pressings. When freeze is selected, display is not updated with incoming target return data. To alert pilot, FRZ label is displayed and is flashed on and off once each second. FRZ is automatically deactivated whenever selection of different control settings dictate a change in displayed data. At system startup, FRZ is automatically off.

(10) ***TEST***. Momentary push button used to select a special test pattern to allow verification of system operation. In test position, transmitter is not enabled, 100-mile range and preset range gain are automatically selected, and TEST is displayed.

(11) ***MAP***. Momentary push button used to select ground-mapping display, MAP is displayed.

(12) ***WX/C***. Alternate action momentary push button used to select weather detection operation. If **WX/C** or **MAP** is selected prior to end of warm-up period, WAIT will be displayed until RT warms up (approximately 60 seconds). After initial startup and warm up, the first press of **WX/C** selects weather operation and WX is displayed. The second press of the push button selects cyclic weather display and CYC is displayed. Displayed red targets flash on and off once per second. Gain is automatically set to preset level.

(13) ***STBY***. Momentary push button used to select standby after radar has been used in an operating mode; e.g., WX or TEST. Standby is useful for keeping radar in ready state while taxiing, loading, etc. In standby, antenna does not scan, transmitter is not enabled, and display memory is erased. STBY is displayed in Mode Field and 100 is displayed as the selected range numeric.

c. Normal Operation.

WARNING

To prevent electromagnetic radiation in ramp, terminal, taxiway, or other areas occupied by personnel, operate radar only in standby mode.

CAUTION

Do not operate radar system, even in standby mode, without 115-Vac, 400-Hz power applied to the system. Without ac power, the receiver-transmitter-cooling blower will not operate, which could result in circuit damage and/or automatic shutdown.

(1) Before Startup. Place the system controls in the following positions before applying power from the aircraft electrical system:

1. **INT / OFF** Switch – **OFF** (fully counterclockwise in detent).
2. **GAIN** – **PRESET** (fully counterclockwise in detent).
3. **TILT** – **+10** (fully clockwise).
4. **STAB** – **ON**.
5. **TGT ALERT** – **OFF.**
6. **AZ MK** – **OFF.**

(2) Precautionary Procedures. If the radar system is to be operated in any mode other than STBY or TEST while the aircraft is on the ground, perform the following steps.

1. Direct nose of aircraft such that antenna scan sector is free of large metallic objects such as hangars or other aircraft for a distance of 100 feet (30 meters) and tilt antenna fully upwards.
2. Avoid operation during refueling of aircraft or other refueling operations within 100 feet (30 meters).
3. Avoid operation if personnel are standing too close in the 270° forward sector of the aircraft.

(3) Self-Test Displays. A distinctive test pattern is displayed when the TEST function is selected. The following procedures may be performed to verify the operational status of the entire radar system.

1. Verify that the preliminary control settings have been made; then rotate **INT / OFF** control to mid-point to turn system on. Verify that STBY is displayed in MODE field and that 100 is displayed as selected range.
2. Press **WX/C** push button and verify that WAIT is displayed in MODE field.

NOTE

A time delay circuit prevents the transmitter from operating and maintains the display blanked until the magnetron has warmed up. When the radar is turned on by pressing the WX/C or MAP push buttons, it will display WAIT and will be in standby for the 1-minute warmup period, automatically become operational in the selected mode.

If none of the push-button switches is pressed, the radar will display STBY and be in the standby mode.

3. Press the **TEST** push button and, when the test pattern displays, verify operation of the intensity control and adjust to desired viewing level.
4. Observe the display; verify that TEST is displayed in the MODE field and that test pattern exhibits the following characteristics.

   a. Range marks and alphanumerics are displayed in cyan.

   b. Color bar and 123 are displayed in auxiliary field.

   c. The colors of the first three target bands are green, yellow, and red.

   d. The color of the fourth target band (65 to 75 nm) is red.

   e. The two red target bands flash on and off approximately once each second.

5. Briefly press **WX/C** push button and slide **TGT ALERT** control to **ON**. Verify that the letter T in a red box appears in the target alert field.

6. Press **TEST** push button and observe that when the test pattern display crosses the centerline, the T is replaced by a flashing TGT label. Slide **TGT ALERT** control to **OFF** to disable the function.

7. Verify that 100 (nm) is displayed in the upper right-hand corner and that the first four range marks are labeled with the correct numerics.

8. Slide **AZ MK** control to **ON** and verify that azimuth marks are displayed in cyan at 30° intervals. Slide **AZ MK** control to **OFF** to remove azimuth marks.

9. Briefly press **WX/C** push button to erase display, press **TEST** push button. After approximately 2 seconds, momentarily press **FRZ** and verify that the 1 2 3 display beneath the color bar is replaced by a flashing FRZ label. Verify that only a portion of the test pattern is displayed and there is no further updating. Momentarily press **FRZ** push button and verify that the display begins updating starting at the current scan position.

10. Press **10** (nm) range push button and verify that the test pattern is momentarily blanked and then restored to the previous display.

11. Briefly press **WX/C** push button and verify that WX displays in the Mode field and 10 displays as the selected range. Verify correct range numerics.

12. Press each range push button in succession (**25** / **50**/ **100** / **200** / **300**) and verify that range numerics change appropriately with each selection.

13. Briefly press **WX/C** push button and verify that CYC is displayed in the Mode field.

14. Rotate **GAIN** control just out of **PRESET** and verily that 1 2 3 remains in the auxiliary field.

15. Briefly press **WX/C** push button and verify that WX is displayed in the mode field and that VAR replaces 1 2 3 in auxiliary field.

16. Briefly press **MAP** push button and verify that MAP is displayed in the Mode field. Verify that the color of the range marks and alphanumerics is green.

17. Briefly press **STBY** push button to return radar to non-transmitting state. Return **GAIN** control to **PRESET**.

(4) Fault Displays. Display colors are continuously monitored by the color bar and 1 2 3 legend in the auxiliary field. If a fault causes a change to unfamiliar colors, the severity level denoted by the faulty color(s) is directly coded by the 1 2 3 legend.

NOTE

If the fault was of transient nature, the system may operate satisfactorily.

Other circuits continuously monitor performance and loading of system power supplies. A fault resulting in power supply operation outside of preset limits will cause the system to shut down and the display will be blank. Should this occur, use the following procedure to recycle the system:

1. Rotate **INT / OFF** control to **OFF**.

2. Verify aircraft radar circuit breaker is on.

3. After a few seconds, rotate **INT / OFF** control to midpoint and press **TEST** push button.

(5) Ground Mapping. Ground mapping operation is selected by pressing the **MAP** push button. Turn the **TILT** control down until the desired amount of terrain is displayed. The degree of down tilt will depend upon the type of terrain, aircraft altitude, and selected range.

For the low ranges (**10**, **25**, and **50**), the transmitter pulse width is narrowed and the receiver bandwidth is widened to enhance the identification of small targets.

(6) Radar Stabilization. The radar stabilization system is designed to maintain the antenna beam at the selected tilt angle relative to the earth's surface. The stabilization system uses the aircraft vertical gyros as a reference and is comprised of electronic amplifiers in the Receiver/Transmitter interconnected with electro-mechanical components in the antenna.

(7) Level Flight. Trim aircraft for straight and level flight in smooth, clear air, over level terrain. Select a 50-mile range and set **STAB** to **OFF**.

Rotate tilt control upward until all ground returns disappear. Then rotate tilt downward until ground returns just begin to appear. After several antenna sweeps, check to see that ground returns are equally displayed. If returns are only on one side of the radar screen or uneven across the radar screen, this indicates a misalignment of the radar antenna mounting and should be corrected before proceeding. Repeat this procedure until a balanced display is achieved.

Once the radar display is correct with stabilization off, select stabilization **ON** and tilt upward once again to remove all returns. Rotate tilt downward and check for even displays of ground returns. If this test indicates improper display, possible errors in the radar stabilization circuits or aircraft gyro exist.

NOTE

It is typical of a processing aircraft gyro to cause ground returns to first appear on one side of the display, have them shift to the opposite side of the display. This precession may not be readily apparent with respect to flight control instruments.

(8) Turns. Once proper operation is established in level flight, rotate the **TILT** control upward in 1° increments until ground returns just disappear, rotate an additional 2° upward.

Place the aircraft in a standard rate turn to the right. Note the radar display. It should be free of returns throughout the turn indicating proper stabilization alignment.

If returns display on the right side of radar indicator, the radar system is understabilizing. Targets on the left side of radar display indicate the system is overstabilizing.

In prolonged turns, gyro precession may occur which will be tracked by the stabilization system and appear as undesirable ground targets on the indicator.

d. Maximum Permissible Exposure Level (MPEL). Heating and radiation effects of weather radar can be hazardous. Personnel should remain at a distance greater than 5 feet from the radiating antenna in order to be outside of the envelope in which radiation exposure levels equal or exceed 10 mW/cm_2. The distance of the MPEL boundary is calculated for the radar system on the basis of radiation diameter, rated peak-power output, and duty cycle.

3C-35. TRANSPONDER – APX-100.

Refer to Paragraph 3-5 for information on the APX-100 Transponder.

3C-36. LIGHTNING DETECTION SYSTEM (WX-1000E).

a. Description. The Stormscope System consists of three components that detect, locate, and map areas of vertical electrical discharge activity contained within thunderstorms. The antenna mounts externally to the aircraft and detects electrical discharges associated with thunderstorms over a 125,000 square mile area around the aircraft. The processor analyzes this information to aid in identification of valid electrical discharges from lightning and to determine range and azimuth for display in the cockpit. The analysis is completed in milliseconds. The location of a vertical electrical discharge associated with a thunderstorm is plotted on the CRT display on the instrument panel as an individual discharge point (+).

b. Controls and Functions.

(1) Power/brightness Control. Rotate to turn on the system and adjust the brightness of the display.

(2) Selector Buttons. The specific function of each button is displayed adjacent to the button in each operating mode.

c. Normal Operation.

(1) Self Test. Each time the system is turned on it will automatically cycle through a series of self-tests which ensure that all major functions are operating properly. These tests, which take approximately 15 seconds to complete, check antenna reception, processor circuitry calibration, memory and microprocessor function, and proper operation of the options. After proper operation has been verified by the self-test program, a confirmation message, ALL TESTS ARE OK will display in reverse video. This message will remain on the display for approximately 3 seconds and then will be replaced automatically with MAIN MENU.

If the system fails any of the internal tests, an error message will display indicating what test failed and what functions may be inoperative. In most cases, all other systems will continue to operate. If continued operation is possible, the message, PRESS ANY KEY TO CONTINUE, will display.

When initially turned on, the system may complete its self-test program before the CRT comes on. In that case, it is possible that the first message that will be seen is the main menu. This is normal operation.

If the weather screen is selected immediately, it is possible the advisory message FLAG will display where heading information is normally displayed. This usually means the gyro system has not yet come up to speed. FLAG should be replaced with heading information momentarily.

(2) Main Menu. The main menu provides access to the two weather mode views and additional system functions, including checklists, time/date information, options, and navaid display. To select a specific menu item, press the **NEXT** button on the display until the desired item is highlighted. Then press the **GO** button to view the selected menu item.

(3) Weather Modes. Two weather mode views are available from the main menu by pressing either the **360**° button or the **120**° button. The symbol → means go to. When the weather mode is initially selected, it will always be in the 200 nm range. Pressing the button beside the range setting will cycle through the additional range selections from 200 nm to 100 nm to 50 nm to 25 nm and back to 200 nm. The 25 nm range is indicated by a solid ring to advise of close proximity to potential thunderstorms. Either view can be selected from the main menu or the opposite view. When changing from one view to another, the range remains constant.

The 120° view provides an expanded view and therefore thunderstorm information is displayed in greater detail. Refer to Figure 3C-23.

Press the **CLEAR** button to erase all weather data from the display and system memory. The intensity of a thunderstorm can be identified by the speed with which the discharge points appear. The system continually receives and processes new electrical discharge information. Monitor this by pressing the **CLEAR** button often. The more intense the storm, the faster the discharge points reappear.

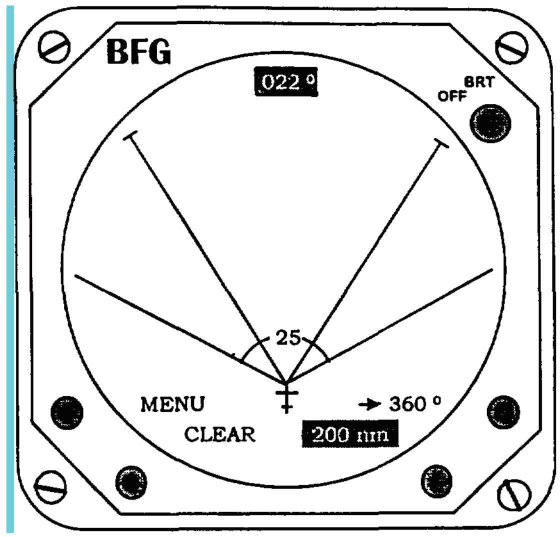


Figure 3C-23. 120° Weather Mode

Multiple discharges, which appear as clusters, are indicative of thunderstorm activity. A large number of discharge points indicate a faster rate of occurrence and, therefore, a more severe thunderstorm. Fewer discharge points indicate a smaller, but not necessarily, weaker, cell. Thunderstorm conditions change rapidly and monitoring their activity over a period of time by use of the **CLEAR** button is recommended. Any grouping of discharge points within the 25 nm range is cause for immediate avoidance.

WARNING

The Stormscope System should never be used to attempt thunderstorm penetration. The FAA and AIM recommend avoiding by at least 20 miles any thunderstorm identified as severe or giving an intense radar echo.

CAUTION

Persistent clusters of two or more discharge points indicate thunderstorms. There are several atmospheric phenomena that can cause isolated discharge points. Clusters of two or more discharge points indicate thunderstorm activity when they re-appear persistently after clearing the screen.

Additionally, should the heading stabilization fail, it is necessary to press the **CLEAR** button for properly oriented data following an aircraft heading change.

Press the **MENU** button to return to the main menu.

(4) Checklist Mode. With specialized equipment, the system can be custom programmed with up to six separate checklists. Each checklist has a capacity of 30 lines with up to 20 characters per line. One of these symbols will display in front of each checklist item on the system display.

- • Item yet to be acted upon
- ✓ Item checked
- · Item skipped

Checklist steps performed are stored in memory so the checklist mode can be exited and the same position returned to later.

The checklist mode can only be selected from the main menu by highlighting **CHECKLISTS** and pressing the **GO** button. When selected, the checklist menu will highlight the first of six checklists programmed. To select a checklist other than the one highlighted, press the **NEXT** button until the desired checklist is highlighted. Then press the **GO** button to display the items contained in that specific checklist. The first unchecked item in each checklist will always appear highlighted. After the highlighted item has been accomplished, press the **CHECK** button. The list will scroll up so the next item on the checklist will be highlighted and a ✓ will display next to the accomplished item. Refer to Figure 3C-24.

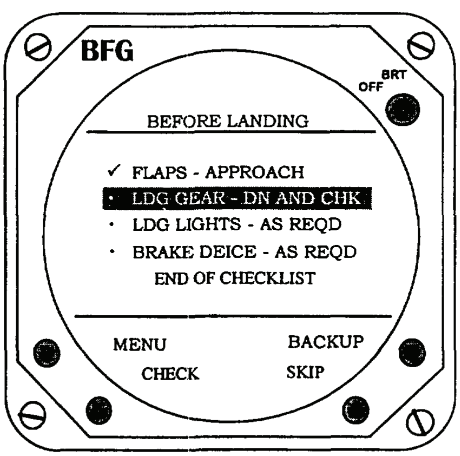


Figure 3C-24. Checklist Mode

To skip an item on the checklist without checking it, press the **SKIP** button. The list will scroll up so the next item will be highlighted and a large dot will display next to the skipped item. All skipped items will display again at the end of the checklist display program. To review the checklist at any time scroll backward with the **BACKUP** button. The last item on each of the checklists is followed by the message END OF CHECKLIST. After all items have been checked a confirmation message CHECKLIST COMPLETE will display and all button legends will disappear except **MENU**.

NOTE

The date is set before the time.

(5) Time/date Mode. The TIME/DATE mode can be selected only from the main menu. The time/date menu displays four items: stopwatch, elapsed time, time of day, and day, month, and year. When first selecting the time/date mode, the stopwatch digits will be highlighted. To use the stopwatch function, press the **START** button to start or stop. Pressing the **RESET** button will immediately reset the timer. To use the elapsed time feature, press the **NEXT** button to highlight the elapsed time digits. Refer to Figure 3C-25. Press the **START** button to start or stop the counter. Pressing the **RESET** button will reset the elapsed timer.

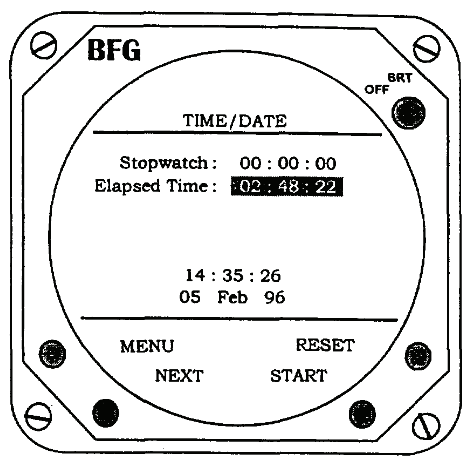


Figure 3C-25. Time/Date Mode

To set the current date or the correct time, press the **NEXT** button to highlight the digits to be changed. Press the **UP** or **DOWN** button to set the digits to the proper value. When either the time or date are highlighted, the **RESET** and **START** button legends are replaced with **UP** and **DOWN**.

(6) Options Mode. The options mode can only be selected from the main menu. The system continuously self-tests many functions. Results are indicated by CONTINUOUS TEST: OK or FAULT. CONTINUOUS TEST. OK indicates that all internal self-test items have been operating properly. The

continuous self-test is intended to advise only of major component failures. The pilot initiated self-test is more extensive than the continuous self-test and is recommended as a check on system operation whenever thunderstorm activity is noted on the display. Press the **TEST** button when in the options mode to manually initiate a test. Refer to Figure 3C-26.

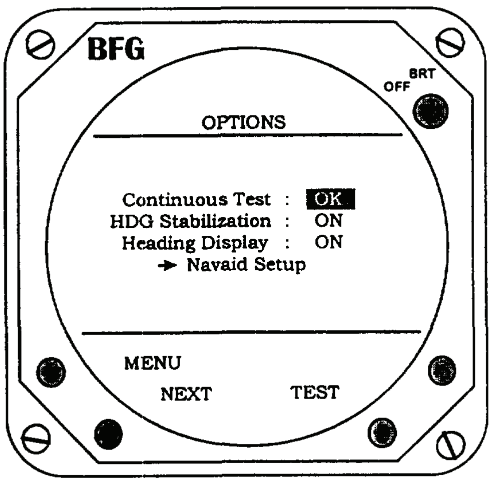


Figure 3C-26. Test Options Mode

The system will initially power up with the heading stabilization feature on. Should the aircraft's heading gyro fail, the heading stabilization feature can be turned off. To turn the heading display on or off, press the **NEXT** button to highlight heading display and press **ON / OFF** as appropriate. Refer to Figure 3C-27. When on, the heading of the aircraft will appear as a digital indication at the top of the display when in either weather mode.

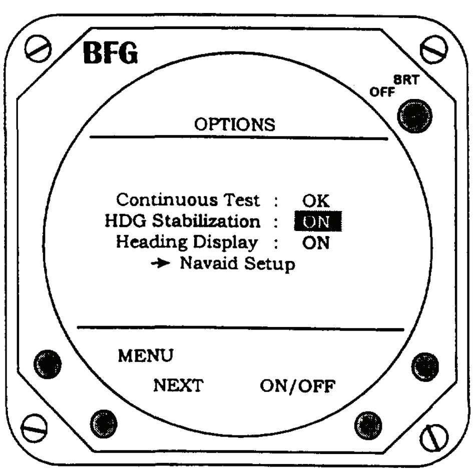


Figure 3C-27. Heading Options

(7) Navaid Option. This option creates a weather avoidance and navigational view. Refer to Figure 3C-28. Using data from the LORAN or GPS, this option provides simultaneous display of both thunderstorm and flight information on the system screen. The course line, selected waypoints, and a course deviation indicator are graphically displayed. Up to 10 waypoints may be displayed within the selected nautical mile range. The CDI is calibrated to indicate the course deviation up to 5 nm on either side of the course line. Up to six user selectable data items can be displayed. The navaid option is selected from the main menu. Display range, groundspeed, estimated time en route, bearing, crosstrack error, and estimated time of arrival are automatically displayed. The data or its position can be changed through the **Navaid Setup** function on the **Options** menu.

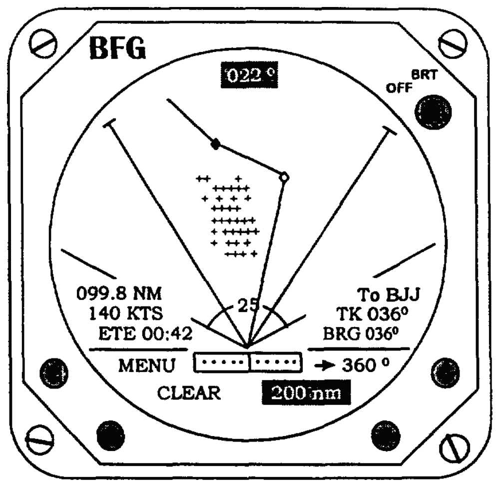


Figure 3C-28. Navaid Option

The Navaid Setup grid lists 14 data items and includes a blank space. Refer to Table 3C-6. Up to six items can be displayed on the weather-mapping screen. To select an item from the grid, move the highlight by pressing the **NEXT** button. Refer to Figure 3C-29. The data items available for selection are dependent upon the specific information provided by the LORAN or GPS receiver. If an item on the grid is not available from the receiver, that grid space will include an asterisk.

Table 3C-6. Navigation Data Items

USER SELECTIONS	ABBR
Bearing to Active Waypoint	Brg
Crosstrack Error	XTK
Estimated Time of Arrival	ETA

Table 3C-6. Navigation Data Items (Continued)

USER SELECTIONS	ABBR
Estimated Time Enroute	ETE
Groundspeed	GS
Latitude	Lat
Longitude	LONG
Magnetic Variation at Present Position	MVar
Minimum Safe Altitude	MSA
Minimum En route Safe Altitude	MESA
Range to Active Waypoint	Rng
Stormscope System Stopwatch	Time
Track	Trk
Waypoint Identifier	WPT

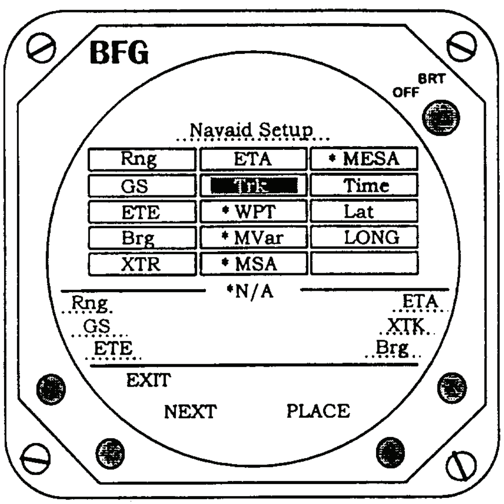


Figure 3C-29. Navaid Setup – Select

To place the item into one of the six positions on the screen, press the **PLACE** button. This places the data item in the upper left position in the legend area. To move the item to another position, press the **MOVE** button. Each additional press of the **MOVE** button advances the item counterclockwise. Refer to Figure 3C-30.

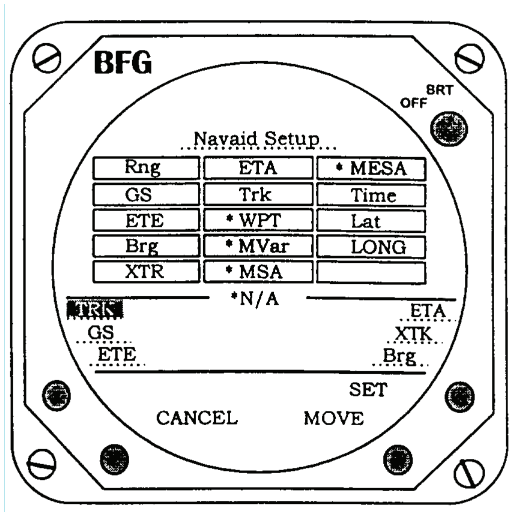


Figure 3C-30. Navaid Setup - Move

To set the display position of a highlighted item, press the **SET** button. This establishes the position of the data item display on the weather screens. After pressing the **SET** button, the highlight will return to the next data item on the grid. To return the data item to the grid without setting it, press the **CANCEL** button. This will return the data item highlight to the grid. Since the data item was not set to the legend area, any data item previously occupying the position will remain there. To select additional data items, repeat the sequence of **NEXT** to highlight the item, **PLACE** it from the grid to the legend area, **MOVE** it to the desired position on the legend area, and **SET** it. To replace a data item previously set in position, follow the same sequence. Pressing the **SET** button when a highlighted data item is in an occupied legend position causes the new item to replace the previous item.

To erase an item from the legend area, press **NEXT** to highlight the blank space on the grid, **PLACE** it to the legend area, **MOVE** it in the legend area to the position to be erased, and **SET** it.

(8) Error Messages. Most common errors and malfunctions are indicated on the display screen. These messages enable service personnel to diagnose and correct the problem. If continued operation is possible, a message to press any key to continue operation will be displayed. When the Loran or GPS receiver fails to acquire a consistent signal and is not certain of its position, the message NAV FLAG will display in place of the CDI. Navigational data will not be displayed if the receiver indicates a flag condition. In conditions where the LORAN or GPS receiver determines its position error to be greater than 1.7 nm, a warning (W) will display next to the affected data items.

3C-37. GROUND COLLISION AVOIDANCE SYSTEM.

WARNING

The ground collision avoidance system will provide little, if any, warning for flight into precipitous terrain approaching a sheer wall if there is little gradually rising terrain before reaching the steep terrain.

The ground collision avoidance system will provide no warning for stabilized descent in the landing configuration into terrain, unless the aircraft is following an operating electronic glideslope or a correct minimum descent altitude has been set on the radio altimeter (activating mode 6).

a. Description. The GCAS is provided to aid the flight crew in terrain avoidance. The GCAS controls and indicators are indicated in Figure 3C-31.

The GCAS is a completely automatic system, requiring no input from the crew, which continuously monitors the aircraft's flight path at altitudes of between 50 and 2,450 feet AGL.

The system provides visual and aural advisory/ warning messages to the crew in the event the aircraft is flown along a projected flight path, which would result in contact with the terrain under any of six modes of operation.

NOTE

The operating temperature range of the computer is –15 °C to 71 °C.

When operating in temperatures below -15 °C, the system may be unreliable.

All alert/warning signals are inhibited below 50 feet AGL.

System messages always precede the "Whoop, Whoop" aural tone and "Pull Up" warnings, thus allowing the crew time to identify and correct the specific flight situation. The system messages and warnings are discussed in the various mode descriptions.

In all GCAS warning modes, the warnings cease and the system resets when the pilot establishes a positive pull up and climb. The system consists of a GCAS computer located in the nose avionics compartment, pilots and copilot’s glareshield warning lights, flight compartment speakers/headsets, a flap override switch, a **GPWS INOP** annunciator light, and a system circuit breaker. The system requires inputs from the aircraft's radio altimeter, air data computer, ILS glideslope receiver, pilot/static system, flap position, and gear position. The GCAS system receives 115 Vac power through a 1-ampere circuit breaker, placarded **GPWS POWER**, located on the copilots’ sidewall circuit breaker panel.

b. Controls, Indicators, and Functions.

(1) GCAS Glareshield Switch-Indicators. The pilot and copilot are each provided with two **GCAS** system switch-indicators located on their respective sides of the glareshield. The left switch-indicator is red and is placarded **PULL UP** in large letters and **GPWS TEST** in smaller white engraved letters below. The right switch-indicator is yellow and is placarded **BELOW GS**. The **PULL UP** indicator lights will flash when the threshold activation limits of modes 1, 2, 3, or 4 have been exceeded. The **BELOW GS** indicator lights will illuminate continuously when the threshold activation limits of mode 5 have been exceeded. Pressing the **BELOW GS** switch-indicator, when below 1000 feet AGL, will deactivate the deviation below glideslope mode. The glideslope mode will be re-armed when the aircraft climbs back through 1000 feet AGL. Pressing the **PULL UP**, **GPWS TEST** switch-indicator will activate the GCAS self test sequence.

(2) GCAS Aural Warning Indications. The following is a list of aural indications. Due to the possibility of activating more than one condition at a time, the following warning priority has been established. A voice annunciation of a higher priority will immediately override a lower priority message in progress. A lower priority message will function only upon the cessation of a higher order warning.

1. "Whoop, whoop, pull up" (modes 1 and 2).
2. "Terrain" (mode 2).
3. "Too low terrain" (mode 4).
4. "Too low gear" (mode 4).
5. "Too low flap" (mode 4).

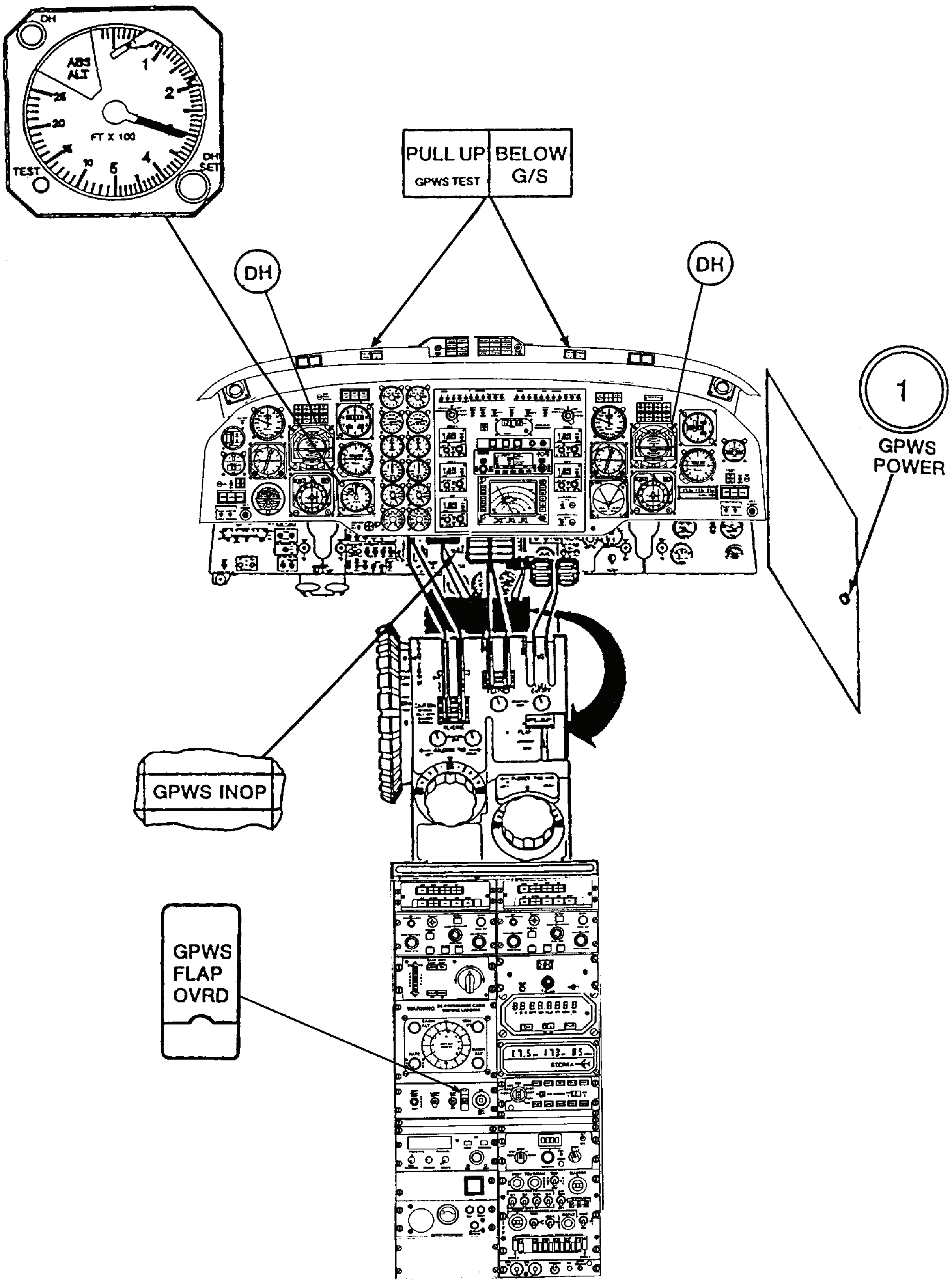


Figure 3C-31. Ground Collision Avoidance System Controls and Indicators

6. "Minimums" (mode 6).

7. "Sink rate" (mode 1).

8. "Don't sink" (mode 3).

9. "Glideslope" (mode 5).

(3) GCAS Flap Override Switch. A guarded switch, placarded **GPWS FLAP OVRD**, located on the pedestal extension, provides a means of disabling the "Too low flap" aural warning to facilitate landing with the flaps in the **UP** position. The "GCAS too low flap," aural warning will not be activated if the flaps are in the **APPROACH** or **LANDING** positions (40° or greater).

(4) GCAS System Inoperative Caution Annunciator Light. Illumination of the cautionary (yellow) annunciator light, placarded **GPWS INOP**, located on the caution/advisory annunciator panel, warns the flight crew that the GCAS is not functional.

c. Normal Operation.

(1) Startup Procedure. The GCAS is operable when the following conditions are met.

1. Battery Switch – **ON**.

2. Inverter Switch – **NO. 1** or **NO. 2**.

3. **AVIONICS MASTER POWER** Switch – On.

4. **GPWS POWER** circuit breaker – In.

5. **GPWS INOP** annunciator light – Extinguished.

(2) GCAS Self-Test.

(a) Pilot's Or Copilot's ***PULL UP / GPWS TEST*** *Switch-Indicator (Glareshield)* – Press and hold. Check for the following indications.

1. Pilot's and copilot's **BELOW GS** switch-indicators (glare-shield) – Illuminated.

2. **GPWS INOP** annunciator light – Illuminated.

3. Warning voice (headsets/ speakers) will say "Glideslope" once.

4. Pilot's and copilot's **PULL UP** switch-indicators will start flashing after approximately 1 second, the "Whoop, whoop, pull up" warning voice will be heard.

5. After several repetitions the "Pull up" voice will stop.

(b) Pilot Or Copilot's ***PULL UP / GPWS TEST*** *Switch-Indicator (Glareshield)* – Release. Check for the following indications.

1. "Pull up" voice will stop, and **PULL UP** light will extinguish.

2. Pilot's and copilot's **BELOW GS** switch-indicators (glareshield) – Extinguished.

3. **GPWS INOP** annunciator light – Extinguished.

NOTE

The self-test may be accomplished while airborne if the radio altitude is above 1000 feet AGL and the landing gear is in the UP position.

(3) Response to Warnings.

(a) When a warning occurs, the flight crew should initiate corrective action to remove the cause of the warning.

(b) When a **PULL UP** warning occurs, immediately apply engine power, establish a positive climb attitude, and climb at the maximum practical rate until the warning cease or terrain clearance is assured.

NOTE

Best climb angle will result in maximum ground clearance in the shortest horizontal distance. Increase pitch attitude smoothly. Large thrust increases may result in a nose-up pitching tendency requiring forward column pressure and trim.

When flying under daylight VFR and a warning threshold is deliberately exceeded or encountered due to specific terrain at certain locations, the warning may be regarded as cautionary and the approach may be continued.

Where operations at specific locations must be conducted in close proximity to terrain, or a flaps up approach is flown, the GPWS FLAP OVRD switch may be set to OVRD to de-sensitize the terrain closure rate warning mode (mode 2). Reset the GPWS FLAP OVRD switch after landing or immediately after making a go-around.

(4) GCAS Modes of Operation. The GCAS operates in the following six modes of operation.

(a) Excessive Sink Rate (Mode 1). Mode 1 provides visual and aural warnings for excessive rate of descent with respect to terrain when below 2450 feet AGL. When the aircraft penetrates the outer warning boundary, the "Sink rate" aural warning will be given and repeated every 0.75 seconds, and **PULL UP** indicator lights on the glareshield will begin to flash. If the rate of descent is not corrected and the second boundary is penetrated, the "Whoop, whoop, pull up" aural warning will sound. The excessive sink rate mode is independent of gear and flap configuration. Refer to Figure 3C-32.

(b) Excessive Terrain Closure Rate (Mode 2). Mode 2 provides visual and aural warnings for excessive terrain closure rate. Refer to Figure 3C-33. The terrain closure rate mode is a function of inputs of airspeed, radio altitude and rate of change, barometric altitude, and gear and flap position. When the aircraft penetrates the outer warning area, the "Terrain" aural warning will sound twice and the **PULL UP** indicator lights will begin flashing. If the excessive closure rate condition remains uncorrected and the inner warning boundary is penetrated, the "Whoop, whoop pull up" aural warning will sound every 0.75 seconds. Upon climbing out of the inner warning boundary, the "Terrain" aural warning will sound every 0.75 seconds, until the aircraft gains an additional 300 feet of barometric altitude.

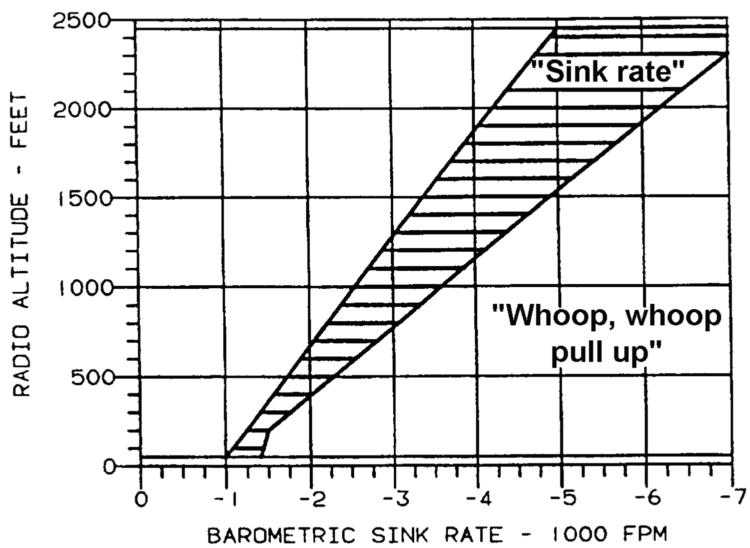


Figure 3C-32. Mode 1 – Excessive Sink Rate

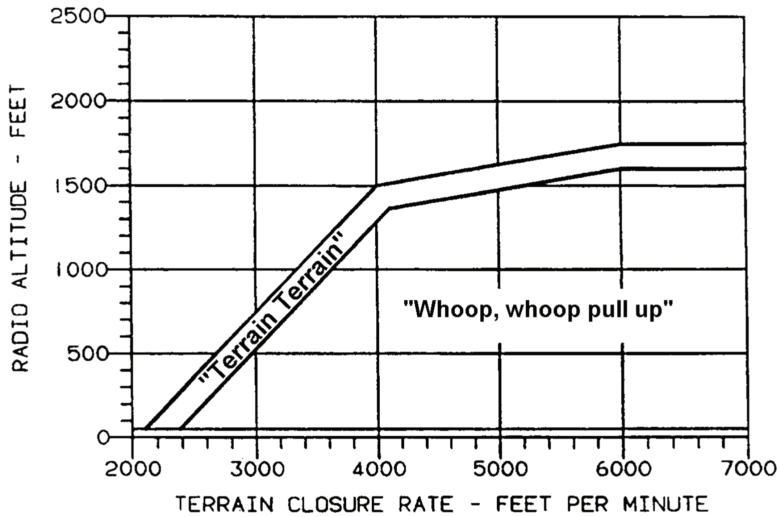


Figure 3C-33. Mode 2 – Excessive Terrain Closure Rate

During an approach with the gear or flaps extended, the 300-foot altitude gain function is inhibited. For altitudes below 700 feet AGL with gear and flaps extended, the "Pull up" aural warning is replaced by the "Terrain" aural warning.

(c) Descent After Takeoff (Mode 3). Mode 3 provides visual and aural warnings for altitude loss after takeoff or missed approach, before attaining 700 feet AGL. Refer to Figure 3C-34. When the aircraft penetrates the warning boundary, a "Don't sink" aural warning will sound and the **PULL UP** glareshield indicator lights will begin to flash. This message will be repeated every 0.75 seconds until a positive rate of climb is established. At this time, the warning ceases but the computer continues to compare the aircraft's barometric altitude to the altitude where the initial descent began. If the aircraft should descend again before climbing to the initial descent altitude, another "Don't sink" warning will be generated based on the original descent altitude. The warning threshold is when approximately 10% of the initial descent altitude has been lost. This mode is active from 65 feet to 700 feet AGL during takeoff or when either flaps or gear are retracted during a missed approach from below 200 feet AGL. Above 700 feet AGL, the computer automatically switches to the terrain clearance mode (mode 4).

(5) Terrain Clearance – Gear Up (Mode 4a). Mode 4a provides visual and aural warnings for terrain clearance with gear up. Refer to Figure 3C-35. The terrain clearance mode with gear up is activated upon climbing through 700 feet AGL after takeoff. When the boundary is penetrated above approximately 175 KIAS the "Too low – terrain" aural warning will be sounded and the **PULL UP** glareshield indicator lights will begin to flash. When the boundary is penetrated below approximately 175 KIAS the "Too low – gear" aural warning will be sounded and the **PULL UP** glareshield indicator lights will begin to flash. In either case, the warnings will be repeated every 0.75 seconds until the condition has been corrected. Mode 4a is inhibited below 50 feet AGL for any gear or flap positions.

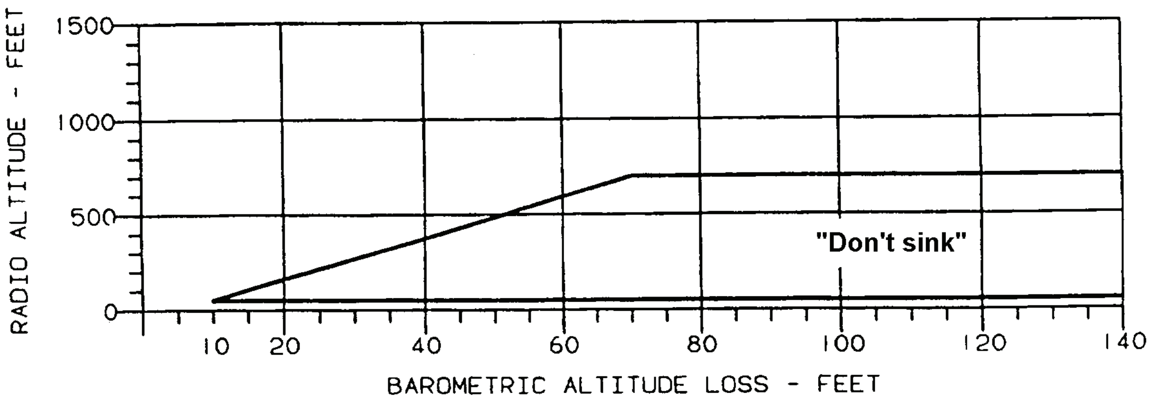


Figure 3C-34. Mode 3 – Descent After Takeoff

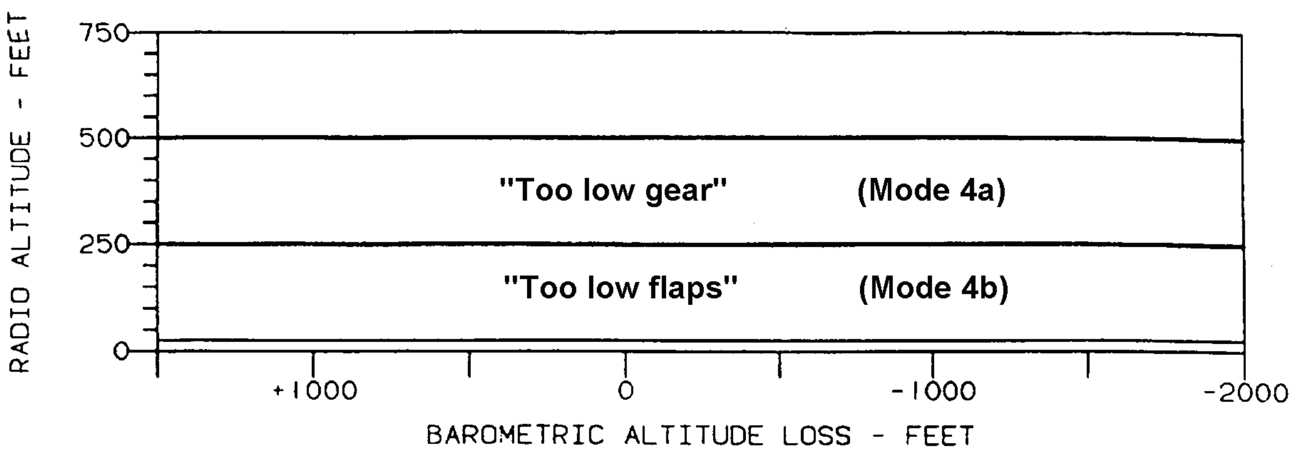


Figure 3C-35. Mode 4 – Proximity To Terrain

(6) Terrain Clearance – Gear Down, Flaps Up (Mode 4b). Mode 4b provides visual and aural warnings for terrain clearance with gear down and flaps less than 40%. When aircraft penetrates the warning boundary at a speed below approximately 145 KIAS with the flaps not extended, the "Too low flaps" aural warning will sound and the **PULL UP** glareshield warning lights will begin to flash. When the boundary is penetrated above approximately 145 KIAS the "Too low – terrain" aural warning will be sounded and the **PULL UP** glareshield indicator lights will begin to flash.

In the event that the landing gear is extended and then retracted, at 200 feet AGL, the "Too low - gear" aural warning will sound and the **PULL-UP** glareshield indicator lights will begin to flash if the gear is still retracted at that time.

Mode 4b is inhibited below 50 feet AGL for any gear or flap position. The computer automatically switches from mode 4b to mode 3 whenever the boundary of mode 4b is passed in full landing configuration (gear and flaps down), or whenever the aircraft is below 50 feet AGL with the gear down.

(7) Descent Below Glideslope (Mode 5). Mode 5 provides visual and aural warnings for descent below glideslope when making an ILS approach. Refer to Figure 3C-36. When the aircraft penetrates the outer warning boundary while on an ILS approach, a "Glideslope" aural warning will be given softly and the **BELOW GS** glareshield indicator lights will be continuously illuminated. If the inner warning boundary is penetrated, the "Glideslope" aural warning repeats faster and at a higher audio level. The glideslope advisory alert may be canceled anywhere

below 1000 feet AGL by pressing the **BELOW GS** glareshield switch-indicator. The deviation below glideslope mode will automatically be reset by climbing above 1000 feet AGL.

(8) Descent Below Selected Radio Altitude (Mode 6). Mode 6 provides aural warning for descending below the radio altitude decision height selected on the radio altimeter indicator with the decision height marker for altitudes between 1000 feet AGL and 50 feet AGL with the landing gear down.

When the aircraft descends below the selected radio altitude the "Minimums" aural warning will sound. The mode will not function again until 1000 feet AGL or 50 feet AGL have been transitioned or the landing gear has been cycled up or down. There are no glareshield warning lights associated with mode 6.

d. Emergency Operation. If an emergency procedure makes it necessary to land with the gear up or some situation makes it necessary to disable the GCAS, pull the **GPWS POWER** circuit breaker located on the copilot's sidewall circuit breaker panel.

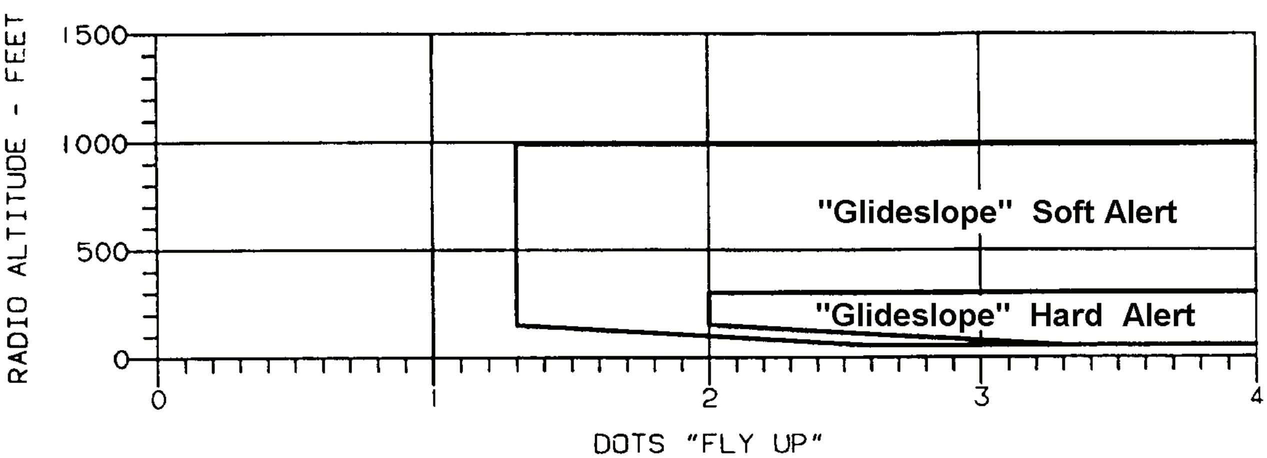


Figure 3C-36. Mode 5 – Descent Below Glideslope

CHAPTER 3D
AVIONICS
GLOBAL POSITIONING SYSTEM KLN 90B T3 F3

3D-1. GENERAL.

Applicability. The KLN-90B Navigation System is only applicable to the C-12T3 and C-12F3 aircraft. The C-12R aircraft utilize the GNS-XLS Flight Management System to access GPS navigation. C-12R crewmembers may remove this chapter.

In the near future the KLN-90B will be removed from the C-12T3 an C-12F3 aircraft and this entire chapter will be removed from the operator's manual.

Description. The Global Positioning System (GPS) is a satellite based radio navigation system that utilizes precise range measurements from GPS satellites to determine precise position anywhere in the world. The KLN 90B provides en route navigation information and non-precision (except localizer, LDA, and SDF) instrument approach navigation.

Components.

KLN 90B Panel. Located above the weather radar on the instrument panel, it contains the GPS sensor, the navigational computer, a CRT display, and all controls required to operate the unit. It also houses the database cartridge that plugs directly into the back of the unit. Refer to Figure 3D-1.

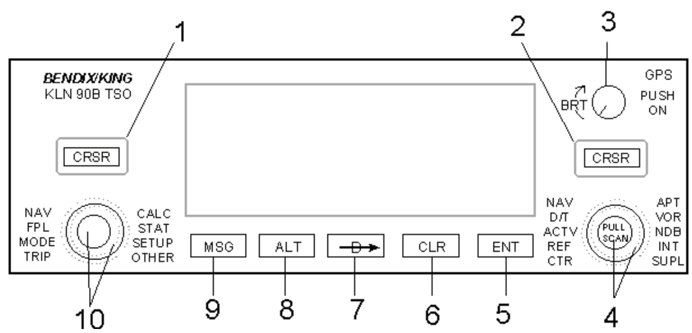
External Annunciators/Switches. A panel located just to the right of the altitude select on the instrument panel contains switches to select **OBS** or **LEG** during en route navigation and a switch to arm the unit during approach. It also has annunciators to indicate when a message is active, when waypoint sequencing is about to occur, and when altitude alerting is occurring. The annunciator panel (F3) also contains a jack to load the database from a laptop computer. Refer to Figure 3D-2.

Antenna. A GPS antenna is located on the top of the fuselage at approximately STA 220.

Power. Vdc to the KLN 90B is provided through a 5-ampere circuit breaker on the copilot's sidewall circuit breaker panel labeled FMS No. 2.

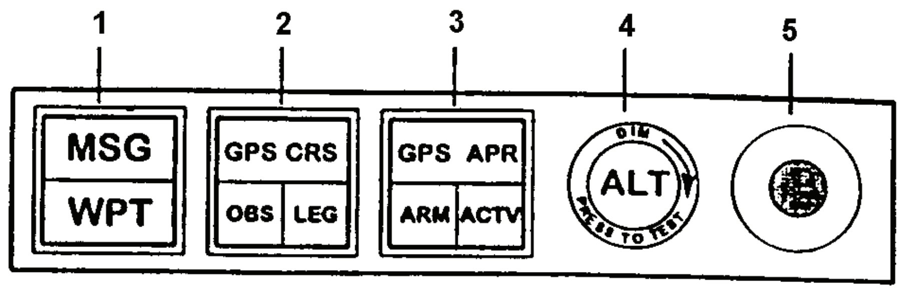
DATABASE.

Database. The databases for the KLN 90B have a primary and a secondary coverage area. All databases contain complete information for all worldwide VOR's, NDB's, and Minimum Safe Altitudes (MSA's). For its primary area, the database contains public use and military airports that have any runway at least 1000 feet in length. For its secondary area, the database also contains airports having a hard surface runway at least 3000 feet in length. Airport communication frequencies and runway information are provided only for airports in the primary area. Intersections, air route traffic control center data, flight service station frequencies, and special use airspace are also provided only for the primary area. Refer to Figure 3D-3.



1. **Left CRSR**
2. **Right CRSR**
3. **Power/BRT Knob**
4. **Right Inner and Outer Concentric Knobs**
5. **ENT Button**
6. **CLR Button**
7. **Direct to Button**
8. **ALT Button**
9. **MSG Button**
10. **Left Inner and Outer Concentric Knobs**

Figure 3D-1. KLN 90B Controls



1. MSG/WPT Annunciator
2. GPS CRS Selector/Annunciator
3. APR Mode Selector/Annunciator
4. Altitude ALT Annunciator
5. Data Loader

Figure 3D-2. F3 KLN 90B External Switches, Annunciators, and Data Loader

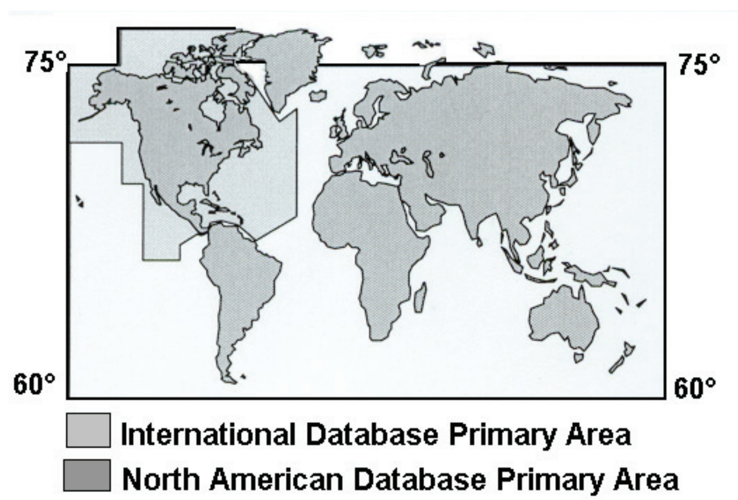


Figure 3D-3. Database Area

The following is a list of the KLN 90B database contents.

NOTE

Items indicated with an asterisk are included in the primary database coverage area, but not in the secondary coverage area. The exception is that airports in the primary coverage area include those public and military bases having a runway at least 1000 feet in length. Airports in the secondary coverage area are those having a hard surface runway at least 3000 feet in length.

Airports.*

(10) Identifier.

(11) Name.

(12) City, State, or Country.

(13) Type (public or military).

(14) Latitude and Longitude.

(15) Elevation.

(16) Approach indicator for precision, non-precision, or no instrument approach at the airport.

(17) Radar approach / departure environment indicator.

(18) Whether airport underlies CL B, TRSA, CL C, CTA, or TMA.

(19) Time relative to UTC (Zulu).

(20) Communication frequencies.

1 ATIS.

2 Clearance delivery.

3 Tower.

4 Ground control.

5 Unicom.

6 Multicom.

7 Approach (IFR).

8 Departure (IFR).

9 Class B, Class C, TRSA, CTA, TMA (VFR).

10 Center (when used for approach).

11 Arrival.

12 Radar.

13 Director.

14 Radio.

15 Automatic Weather Observing Station (AWOS).

16 Aeronautical Advisory Service (AAS).

17 Aerodrome Traffic Frequency (ATF).

18 Common Traffic Advisory Frequency (CTAF).

19 Mandatory Frequency (MF).

20 Ramp control..

21 PCL (pilot controlled lights).

(21) Runway data (designation, length, surface, lighting, traffic pattern direction).

(22) Airport services (fuel, oxygen, customs, and indicator for presence of a landing fee).

(23) Airport comments (user may manually enter remarks of up to 33 characters at any 100 airports in the database).

VOR's.

a. Identifier.

(24) Name.

(25) Frequency.

(26) DME indicator.

(27) Class (high altitude, low altitude, terminal, undefined).

(28) Latitude and Longitude.

(29) Magnetic variation.

NDB's.

b. Identifier.

c. Name.

d. Frequency.

e. Latitude and Longitude

NOTE

Outer compass locators are stored as intersections.

Intersections.* (low altitude, high altitude, SID/STAR, approach, and outer markers).

f. Identifier.

g. Latitude and Longitude.

SID/STAR/Approach Procedures.*

h. All compatible pilot NAV SID/STAR procedures.

i. Non-precision approaches (except localizer, Localizer Directional Aid (LDA) and Simplified Directional Facility (SDF) approved for overlay use. Includes all public GPS only approaches.

Miscellaneous.

j. Air Route Traffic Control Center (ARTCC's and FIR's) boundaries and frequencies (VHF and HF).

k. Flight Service Stations (location of points of communication and associated frequencies – VHF and HF).

l. Minimum safe altitudes.

m. Special Use Airspace boundaries (Prohibited, Restricted, Warning, Alert, MOA, Class B, TRSA, Class C, CTA, TMA).

250 User-Defined Waypoints.

n. Identifier.

o. Latitude and Longitude.

p. Additional data depending on how user defines waypoint:

1 User airports (elevation and surface of longest runway).

2 User VOR (frequency and magnetic variation).

3 User NDB (frequency).

Waypoints are stored in the KLN 90B database almost exclusively by their ICAO identifiers.

NOTE

There are several exceptions in Alaska. In many cases, airports with three letter identifiers receive the prefix P, but there are many that don't. The most reliable method of determining an Alaska airport identifier is to look it up from the airport name or city.

Not all airports receive the prefix letter. Airport identifiers that are combinations of letters and numbers do not receive the prefix letter.

Database Update. There are two ways to update the database.

Cartridge Exchange. The new update may be installed any time prior to the effective date and the KLN 90B will use the previous data up to the effective date and automatically begin using the new data on the effective date.

Insert the KLN 90B insertion/ removal tool in the small hole located on the right side of the unit. A standard 3/32 inch Allen wrench may also be used.

Turn tool counterclockwise until the locking mechanism becomes loose and then continue turning counterclockwise until it just barely begins to become snug. Do not turn so far counter-clockwise that the mechanism starts to bind and can no longer be turned.

Pull the unit out of the rack by pulling on the sides of the panel. DO NOT PULL ON THE KNOBS.

Remove the old cartridge by pulling it straight out of the back.

Insert new cartridge into the back of the KLN 90B as indicated by the label on the cartridge. When the cartridge is properly inserted, the "Insert To Here" marking on the label can just be seen protruding from the rear of the unit.

Make sure the front lug of the locking mechanism is in the up position and insert unit into the rack as far as it can go.

Re-insert tool and turn clockwise until snug. Pull gently on front panel to verify unit is locked into the rack.

Laptop Computer Using 3.5" Diskettes.

Plug 9-pin female connector end of interface cable into a COM serial port of computer.

Plug the other end of the interface cable into the data loader jack on the annunciator panel.

Turn on computer, insert Disk 1 and the program will automatically load and the screen will indicate ready.

Turn on the KLN 90B. Press **ENT** as required to approve the Self Test and Database pages. Use the left outer knob to select the Setup (SET) type pages and the left inner knob to select the SET 0 page.

NOTE

In steps 5, 6, and 7, repeated presses of CLR terminates the process and brings the display back to the original SET 0 page.

Press the left CRSR. UPDATE PUBLISHED DB will now be displayed.

Press **ENT**. The database region and expiration date of the database presently loaded will be displayed. If the database is out of date, the word EXPIRES changes to EXPIRED.

Press **ENT** to acknowledge the information on this page and to continue the update procedure. The estimated load time in minutes is displayed.

Press **ENT** to acknowledge the estimated load time and begin erasing the existing database. The unit will display, ERASING DATABASE. After the database has been erased, loading of the new database will begin automatically. As the new data is loaded, the percentage of transfer will be displayed.

When disk 1 is complete, the screen will display, "Insert Disk 2." Press any key to continue. Remove disk 1 and insert disk 2 and press any key on the computer. The load operation will continue. If the database has three disks, the computer will prompt when to insert disk 3.

The KLN 90B will indicate when the database update is complete and display the expiration date. You may turn the unit off at this time or press **ENT** to restart the KLN 90B.

CAUTION

Update of the database must be conducted on the ground. The KLN 90B will not perform navigation functions during updates. An update of database requires 10 minutes.

The accuracy of the database information is only assured if it is used before the end of the effective period.

The KLN 90B contains an internal lithium battery that is used to retain the user-defined database as well as the flight plans.

The KLN 90B was designed to provide worldwide navigation coverage from North 74° latitude to South 60° latitude. Outside this area, magnetic variation must be manually entered.

TURN-ON AND SELF-TEST.

Turn On. Turn on the KLN 90B by pressing the power/brightness knob to the IN position. It takes a few seconds for the screen to warm up.

Self-Test. The turn-on page will be displayed for a few seconds. During this time, the KLN 90B performs an extensive internal test. When the internal test is complete, the Self-Test page will automatically replace the Turn-On page. Refer to Figure 3D-4.

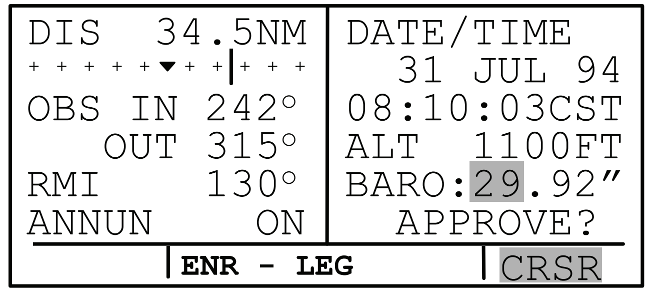


Figure 3D-4. Self-Test Page

Adjust the display brightness to the desired level by rotating the power/brightness knob.

Verify the data displayed on the left side of the self-test page is the same as is being displayed on the EHSI's. The distance field always displays 34.5 nautical miles. The deviation bar on the EHSI should be indicating a half scale right deviation. The TO / FROM indicator should be showing FROM. The OBS out field always displays 315°. If the EHSI is capable of being driven by the KLN 90B, the course pointer on the EHSI should be driven to 315° and both the OBS IN and OBS OUT fields should be displaying 315°. The RMI field always displays 130°. The copilot's RMI should indicate a bearing to the station of 130°.

If the KLN 90B has passed the internal self-test, the bottom left side of the Self-Test page will display ANNUN ON to indicate that the external annunciators should all be illuminated. If a flashing TEST FAIL is displayed, recycle power to the KLN 90B. If the Self-Test page still displays TEST FAIL, the KLN 90B requires repair and should not be used for navigation.

Correct Time, Date, and Position.

The KLN 90B needs to have the correct time, date, and position to be able to determine which satellites should be in view. This information is stored in the battery-backed memory of the KLN 90B so it is not normally necessary to update it. If the KLN 90B has the correct date, time, and position, the time to NAV ready will usually be 2 minutes or less. If this information is not correct, the KLN 90B will start to look for satellites to determine the position of the aircraft. This process can take as long as 12 minutes but will normally be around 6 minutes. It is possible to update this information manually, which will allow the KLN 90B to reach a NAV ready status much faster. If the date and time are correct, or acquisition time is not important, proceed to step d.

If the date is incorrect, rotate the right outer knob counterclockwise until the cursor is over the date field.

Rotate the right inner knob until the correct day of the month is displayed. Then, rotate the right outer knob one step clockwise to place the flashing part of the cursor over the month field. Rotate the right inner knob to display the correct month. Rotate the right outer knob one step clockwise again and use the right inner knob to select the first digit of the correct year. Next, rotate the right outer knob one more step clockwise and then use the right inner knob to select the second digit of the year. When the date is correct, press **ENT**.

If it is necessary to reset the time, use the right outer knob to position the cursor over the time zone field. Use the right inner knob to select one of 19 time zones. UTC – Coordinated Universal Time (Zulu) is always a safe choice. Then turn the right outer knob one step counterclockwise to position the cursor over the time field. Use the right inner knob to select the correct hour. Twenty-four hour time is used. Now turn the right outer knob one step clockwise to position the flashing part of the cursor over the first minutes position. Turn the right inner knob to select the desired value. Turning the right outer knob one more step clockwise positions the flashing cursor over the second minutes position, and the right inner knob is now used to finalize the time selection. When the correct time has been entered, press **ENT** to start the clock running. The KLN 90B system time will automatically be corrected very precisely once a satellite is received.

Altimeter Setting.

With the Army Engine Trend Monitoring (AETM) system installed and interfaced with the appropriate altimeter, the correct barometric altimeter setting is input via the pilot's altimeter. It will not be possible to access the BARO field on the Self-Test page or the Altitude page. If there is no colon after the BARO field, it cannot be accessed by the pilot with the controls on the KLN 90B. In the F3, steps 2 and 3 are required to input altimeter information. Normally in the T3, altimeter information is automatically input; If not functioning correctly, then steps 2 and 3 are required to input altimeter information.

Turn the right outer knob clockwise to position the cursor over the first two digits of the barometric altimeter setting if the cursor is not already there. If the correct altimeter setting is displayed, skip to step (4).

To enter the correct altimeter setting, rotate the right inner knob to select the first two digits. Rotate the right outer knob one step clockwise to move the flashing cursor over the third position. Use the right inner knob to select the correct number. Use the right outer knob and inner knobs to complete the altimeter setting and press **ENT**.

With the correct altimeter setting entered, the altitude displayed on line 4 should be correct within 100 feet.

Approve Self-Test Page. Turn the right outer knob clockwise to position the cursor over APPROVE? if it is not there already. Press **ENT** to approve the Self-Test page. In the F3, Five beeps should be heard when the Self-Test page is approved to confirm altitude alert audio. If the **GPS CRS** switch is in the **OBS** position, the OBS warning page will be displayed and **GPS CRS** switch should be pushed so that the LEG mode is selected.

Acknowledge Self-Test Page. The database page will now be displayed with the cursor over ACKNOWLEDGE?. Line 1 indicates the coverage area. Line 3 will show the date the database expires. The KLN 90B will still function with an out of data database.

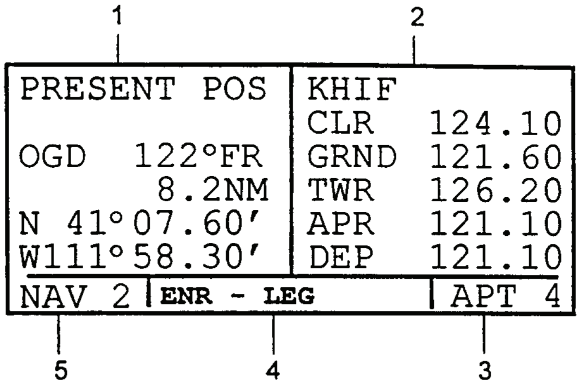
CAUTION

The accuracy of the database information is assured only if the database is current.

Press **ENT** to acknowledge the information on the Database page.

The NAV 2, Present Position, page is now automatically displayed on the left side of the screen and the Waypoint page which was active when the KLN 90B was last turned off will be displayed on the right side. Refer to Figure 3D-5. If the last active waypoint was an airport, the APT 4 page (airport communications) will be displayed.

When the NAV 2 page first displays, it is possible that the present position will be dashed. It can take the KLN 90B several minutes to acquire the GPS satellites and to make its initial calculation of its position. When it reaches a NAV ready status and is able to navigate, the NAV 2 page will display the present position in two ways. The bottom of the page will display the aircraft's latitude and longitude. Above the latitude/longitude position is the present position expressed as the distance and radial from a nearby VOR. The VOR displayed on the NAV 2 page is the nearest low or high altitude class VOR. Terminal class VOR's are not used because many charts do not depict a compass rose around them and verifying the displayed radial would be difficult. Verify that the present position shown on the NAV 2 page is correct.



1. **Left Information/Data Page**
2. **Right Information/Data Page**
3. **Right Page Identifier**
4. **Center Segment**
5. **Left Page Identifier**

Figure 3D-5. Present Position Page

NOTE

The aircraft must be located such that the GPS antenna has an unobstructed view of the sky so that required satellite signals are not being blocked. If necessary, position the aircraft away from hangars or other obstructions.

DISPLAY FORMAT.

The KLN 90B uses a Cathode Ray Tube (CRT) display. The display screen is divided into segments. These segments are formed by horizontal and vertical lines on the screen. Most of the time there are five segments. Aeronautical information/data is presented on the screen in the form of pages. A page is a presentation of specific data in an organized format. Various page types are used to display related kinds of data. One page type is NAV for navigational data and another is APT for airport information.

When the screen is divided in five segments, the KLN 90B displays two pages at one time. These pages are presented in the upper left and upper right segments of the screen. The lower left segment indicates what specific page is being displayed on the left side. The lower right segment indicates what specific page is being displayed on the right side. The page identification includes a number appended to the page type when there is more than one page for a page type. There is no number displayed in the page identifier if there is only one page for a particular page type. Whenever a + sign is part of a page identifier, there will be two or more pages, all having the same page number, used to present all of the information. That is, all of the information associated with a particular page number doesn't fit on the page being viewed.

The lower center segment of the display is used to present four different kinds of information. The first seven spaces of the segment indicate the mode in which the KLN 90B is operating. The last three spaces are usually blank but may contain the characters MSG or ENT. The characters MSG indicate that there is a message to be viewed on the Message page. The characters ENT will flash in these spaces when it is necessary to press the **ENT** button. This segment is also used for displaying short operational messages called status line messages. A complete listing of status line messages is contained in Paragraph 3D-29.b.

BASIC OPERATION OF CONTROLS.

The KLN 90B has five knobs and seven buttons that are used to perform all operations. In general, the two concentric knobs and the CRSR button located on the left side of the unit are used to select pages and enter data on the left side of the screen. Likewise, the two concentric knobs and the CRSR button on the right side of the unit are used to select pages and enter data on the right side of the screen.

The cursor is an area of inverse video on the screen. On many pages, data can be added, deleted, or changed by first pressing the appropriate **CRSR** button to turn the cursor function on and bring the cursor on the screen. The appropriate knobs are then used to enter the data. When a cursor is on the screen, the page name normally shown in the left and right lower segments is replaced with a CRSR annunciation in inverse video.

Page Selection. The left outer knob is rotated to select one of eight page types for the left side of the screen. Refer to Table 3D-1.

NOTE

The cursor function must be off.

Rotating the left outer knob one detent clockwise or counterclockwise selects the page type marked on the knob in that direction. Once the page type has been selected with the left outer knob, the page number is selected by rotating the left inner knob.

The right side operates in a similar manner. The navigation pages are available on both sides. The remainder of the page types are different. Refer to Table 3D-2.

Only the right inner knob has both an in and an out position. With the knob pushed in, it works exactly as the left inner knob. In the out position, it performs a waypoint scan function. The usual position for the right inner knob is the in position.

Waypoint Data Entry.

Press cursor to turn on the cursor function.

Rotate the outer knob to position the cursor in the desired location. The location will vary. Waypoint identifiers will be in different places on the page depending on the type page selected.

Rotate the inner knob to select the first character of the waypoint identifier.

Table 3D-1. Left Side Types

PAGE IDENTIFIER	KNOB MARKING	PAGE NAME	PAGE NUMBERS
TRI	TRIP	Trip Planning	0-6
MOD	MODE	Mode	1-2
FPL	FPL	Flight Plan	0-25
NAV	NAV	Navigation	1-5
CAL	CALC	Calculator	1-7
STA	STAT	Status	1-5
SET	SETUP	Setup	0-9
OTH	OTHER	Other	1-4*
*Up to 10 with fuel management system and air data interfaces			

Table 3D-2. Right Side Page Types

PAGE IDENTIFIER	KNOB MARKING	PAGE NAME	PAGE NUMBER
CTR	CTR	Center WPT	1-2
REF	REF	Reference WPT	None
ACT	ACTV	Active WPT	*
D/T	D/T	Distance/Time	1-4
NAV	NAV	Navigation	1-5
APT	APT	Airport WPT	1-8
VOR	VOR	VOR WPT	None
NDB	NDB	NBD WPT	None
INT	INT	Intersection WPT	None
SUP	SUPL	Supplemental WPT	None
*Varies with the type of waypoints in the active flight plan			

Move the outer knob one step clockwise to move the cursor to the second character position.

Rotate the inner knob to select the second character.

Use the outer and inner knobs in this manner until the complete waypoint identifier is displayed.

If the waypoint is being entered on a page on the left screen when ENT is flashing in the lower middle segment of the display, press the **ENT** button. This will display a waypoint page on the right side of the screen for the identifier just entered.

Verify the waypoint information displayed, press the **ENT** button again to approve the waypoint entry. The right side will return to the page previously displayed.

Alternate Waypoint Data Entry. This method applies when there is a page on the left side of the screen with the cursor over a field where a waypoint can be entered. Fill the waypoint on the left side by first selecting the desired waypoint page on the right side. When the **ENT** button is pressed, the waypoint field on the left will contain the flashing identifier of the waypoint that is displayed on the right side. To finalize the selection, press the **ENT** button again.

The Duplicate Waypoint Page. There are some waypoints in the database with the same identifier. When a waypoint identifier has been entered that is not unique to a single waypoint, a duplicate waypoint page displays on the left side. The duplicate waypoint page is used to select which of the waypoints having the same identifier is actually desired. The waypoint identifier is displayed on the top left of the page. Refer to Figure 3D-6.

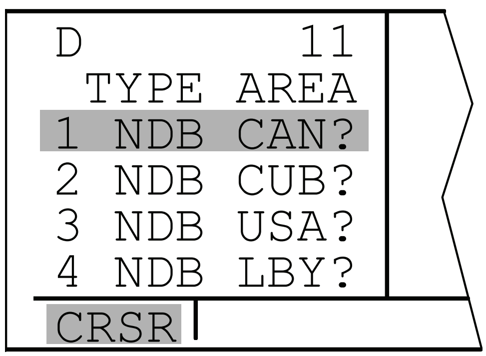


Figure 3D-6. Duplicate Waypoint Page

To the right of the identifier is the number of waypoints in the database having the identifier. Below the identifier is a list if the waypoint types and the associated countries which use the identifier. If there are more than four waypoints having the same identifier, only the first four are initially shown. The cursor will be over the first waypoint listed. They are listed with the waypoint closest to the aircraft's present position displayed first and the waypoint farthest from the aircraft displayed last. To view the rest, rotate the left outer knob clockwise. Doing so will move the cursor over waypoints two, three, and four and then will cause the waypoint list to scroll so that the other waypoints in the list may be seen. To select the desired waypoint:

Move the cursor over the appropriate choice.

Press the **ENT** button to view the waypoint page for the selected waypoint.

Press the **ENT** button again to approve the entry of the waypoint.

MESSAGE PAGE.

The MSG prompt flashing in inverse video at the bottom of the display indicates a situation that requires attention. View the message at the earliest opportunity. To view the message, press the **MSG** button. The message page, which takes up the whole width of the display, will appear and show the new message. It is possible that several messages are displayed at one time on the message page. The newest message displays first and the rest in reverse chronological order.

After reading the message, press the **MSG** button again to return to the pages that were previously in view. If all the messages cannot be displayed on one page, repeated presses of the **MSG** button will show the other messages before returning to the pages that were previously in view. Whenever a message condition exists which requires a specific action, the message prompt will remain on but not flashing.

INITIALIZATION.

Since the KLN 90B stores its position and other required parameters in memory when power to the unit is removed, it is seldom necessary to aid the unit in reaching a NAV ready status. In order for the unit to reach a NAV ready condition, it is necessary to meet the following conditions.

The KLN 90B's almanac data must be current. Almanac data is crude orbital information for all the satellites and is used for initial acquisition when the unit is first turned on. This data is stored in the KLN 90B's non-volatile memory and is considered current up to 6 months. Each satellite sends almanac data for all satellites. Since the KLN 90B routinely updates the almanac data during normal operation, the almanac data will become out of date only if the KLN 90B hasn't been used for the previous 6 months or longer. Collecting new almanac data takes place automatically if the data is more than 6 months old. This will usually take about 6 minutes, but no more than 12 minutes.

The aircraft must be located so the GPS antenna has an unobstructed view of the sky.

It is very helpful for the KLN 90B to have the correct date, time, and position. This information is stored in the battery-backed memory of the KLN 90B so it is not normally required to update it. If acquisition time is not important, it is not necessary to update the date, time, and position. See paragraph 3D-2.c for setting the date and time, if necessary.

Select the Setup 1 page by first turning the left outer knob to **SETUP** displaying a SET page annunciated in the lower left segment of the display. Next, turn the left inner knob until the SET 1 page is selected.

Press the left **CRSR** button to bring the cursor on the page over the WPT field.

Use the left inner knob to enter characters and the left outer knob to move the cursor until the identifier for the location is entered.

Press the **ENT** button to view the waypoint page on the right side.

Press the **ENT** button again to approve the entry.

NOTE

As an alternative, the latitude and longitude of the present position can be entered directly instead of entering a waypoint identifier.

Use the left outer knob to position the cursor over CONFIRM?.

Press the **ENT** button.

NOTE

The groundspeed and heading fields are not used for initialization in the aircraft. If the KLN 90B is in the take-home mode, entering a groundspeed will allow the KLN 90B to fly along the active flight plan (or direct to a waypoint) starting from the initialization waypoint. A heading may be entered in the initial heading field while in the take-home mode if the one offered is not desired. If the take-home mode is used, the KLN 90B must be initialized to the aircraft's location when it is re-installed.

Use the left knobs to select the NAV 2 page. When the KLN 90B reaches the NAV ready status and is able to navigate, the NAV 2 page will display the present position. Verify the latitude and longitude or the VOR radial and distance displays are correct.

SELECTING WAYPOINTS.

There are five types of waypoints: airports, VOR's, NDB's, intersections, and supplemental. Waypoints in the published database fall into one of the first four types. Up to 250 user-defined waypoints may be created and defined as any of the five types. There are three methods to select a specific waypoint for viewing: enter the waypoint's identifier directly, scan through the waypoint identifiers in alphabetical order, or enter the waypoint's name. If the waypoint is an airport, it may also be selected by entering the city where the airport is located.

Selecting Waypoints By Identifier. The most direct way of selecting a specific waypoint is to enter the identifier directly on the appropriate waypoint page.

Rotate the right outer knob to select the appropriate waypoint type page. For the airport type waypoints, rotate the right inner knob to select the APT 1 page if it is not already in view. The airport identifier can be entered on any of the eight airport pages but the APT 1 page displays the airport name.

Press the right **CRSR** button to bring the cursor on the screen over the first character of the identifier. Check the right inner knob in the in position.

Turn the right inner knob to select the first character of the identifier. Airports that have four letter identifiers require all four letters. Turn the knob either clockwise or counterclockwise. The letters and numbers wrap around with a blank character separating the 9 and the A. Turn the knob clockwise to scan through the characters in alphabetical order, or counterclockwise to scan in reverse alphabetical order. Numbers are considered lower than letters.

Rotate the right outer knob one step clockwise to position the cursor over the second character of the identifier.

Use the right inner knob to select the second character of the identifier.

Use the right outer and right inner knobs in the same manner as above to select the remainder of the identifier.

Press the right **CRSR** button to remove the cursor from the right page.

If the waypoint is an airport, the APT 2 through APT 8 pages may be viewed by rotating the right inner knob. Many times not all of the characters of a waypoint identifier need to be entered. Every time a character is entered, the KLN 90B searches its database to offer the first waypoint in the database that begins with the characters that have been entered so far.

Selecting Waypoints By Scanning.

Select the desired waypoint type on the right side by using the right outer knob.

Pull the right inner knob to the out position.

Turn the right inner knob clockwise to scan through the waypoints in alphabetical order, or counter-clockwise to scan in reverse alphabetical order. Numbers are considered lower than letters. The faster the knob is turned the larger the step through the waypoints. This variable rate scanning allows quick movement through the list. When the knob is turned slowly, the waypoints are scanned one at a time.

A list if the nine waypoints nearest to the present location is located at the beginning of the complete lists for airports, VOR's, and NDB's. It is necessary to scan backwards, turn the knob counterclockwise, through the complete list to reach the nearest list. The top right portion of the page will flash the relative position of the waypoint to the present position. Refer to Figure 3D-7. NR 1 indicates the nearest while NR 9 indicates the ninth nearest. Waypoint pages displayed in the nearest list do not contain a latitude and a longitude position as they do in the complete list. Instead, the bearing and distance to the waypoint are displayed. In addition, nearest airport pages display the length, surface, and lighting of the longest runway. Once the nearest airport is displayed, the other airport pages for the airport are available for display by making sure the right inner knob is pressed in and then turning it to select the desired airport page.

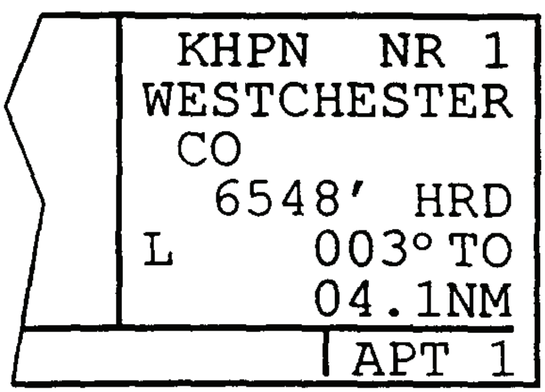


Figure 3D-7. Nearest Airport Page

NOTE

The capability to display nearest airports exists only when the KLN 90B is actually operating in the primary database coverage area. For example, if the KLN 90B contains a North American database it will not display the nearest airports while operating in South America.

In the event of an emergency, a special procedure exists to very quickly get to the beginning of the nearest airport list.

1. **MSG** button – Press.
2. **ENT** button – Press.

The waypoint page for the nearest airport is now displayed on the right side. The right inner knob may now be used in the normal manner to scan the other nearest airports, knob in the "out" position, or to view all eight airport pages for a specific airport, knob in the in position.

When the nearest airport page is initially displayed, NR 1 is displayed in the upper right hand corner of the page to designate this airport as the nearest airport. However, if flight is continued along the flight plan with this page selected, the same airport will be displayed and its position in the nearest airports list will change from NR 1 to NR 2, NR 3 … NR 9 until it won't be on the nearest airport list. The reason for this is that in the event of an actual emergency, once an airport has been selected, the list won't update while maneuvering or looking up data on other airport pages. To have the NR 1 continuously change to reflect the nearest airport, perform the following steps.

3. Display the nearest airport page by pressing the **MSG** button followed by pressing the **ENT** button.

Press the right **CRSR** button.

Rotate the right outer knob clockwise to position the cursor over NR 1. As long as the cursor is left in this position, this page will update so that the nearest airport is always shown as the flight progresses.

Selecting Waypoints by Name or City. For VOR's and NDB's, the navaid name may be used. For airports, the airport name on the APT 1 page or the city name on the APT 2 page may be used.

Turn the right outer knob to display the VOR, NDB, or airport type waypoint. For the airport type waypoint, use the right inner knob to select APT 1, for airport name, or APT 2, for airport location, as appropriate.

Press the right **CRSR** button. Make sure the right inner button is pushed to the "in" position.

Rotate the right outer knob clockwise until the cursor is over the first character in the VOR name, NDB name, airport name, or airport city name.

Turn the right inner knob to display the first character.

Turn the right outer knob one step clockwise and then use the right inner knob to enter the second character.

Use the right outer and inner knob as before to select the remaining characters.

Press the right **CRSR** button to turn off the cursor function.

Instead of an entire name, a few characters may be entered and then the waypoints that begin with those characters may be scanned.

Turn the right outer knob to display the VOR, NDB, or airport type waypoint. For the airport type waypoint, use the right inner knob to select APT 1 or APT 2 as appropriate.

Press the right **CRSR** button. Make sure the right inner button is pushed to the in position.

Rotate the right outer knob clockwise until the cursor is over the first character in the VOR name, NDB name, airport name, or airport city name.

Turn the right inner knob to display the first character.

Turn the right outer knob one step clockwise and then use the right inner knob to enter the second character.

Use the right outer and inner knobs in the same manner to select as many characters as desired.

Now all names that begin with the selected characters can be scanned.

Pull the right inner knob to the out position.

Turn the right inner knob (in the out position) to scan all names beginning with the selected characters.

If desired, the right inner knob may be pushed back in and more characters added to the name.

When complete, push the right inner knob in and press the **CRSR** button to turn off the cursor function.

There are a few changes made to names in order to accommodate the KLN 90B display. Names that are too long to fit on the display are abbreviated. The first six characters are usually exactly correct, with some exceptions. Refer to Table 3D-3 for a list of exceptions.

Table 3D-3. Abbreviations

North, Northern, East, Eastern, etc.	N, E
Southeast, Northwest, etc.	SE, NW
Point	PT
Port	PT
Fort	FT
Saint	ST
General	GEN

Person's name – uses initials for other than last name unless very well known (Will Rogers).

Delete "City of" (City of Colorado Springs).

Delete "Greater" (Greater Buffalo).

Delete "The."

Unless the first word is greater than eight characters, it is usually not abbreviated.

Delete most punctuation such as period and apostrophes.

Abbreviations for International are INTL, INT, and IN.

Abbreviations for Regional are REGL and REG.

DIRECT TO OPERATION.

The **D→** button is used to initiate navigation from the present position direct to a waypoint. When the **D→** button is pressed, the Direct To page, Figure 3D-8, will be displayed on the left side with a flashing cursor over a waypoint identifier. The waypoint identifier that displays on the Direct To page is chosen by the KLN 90B according to the following rules.

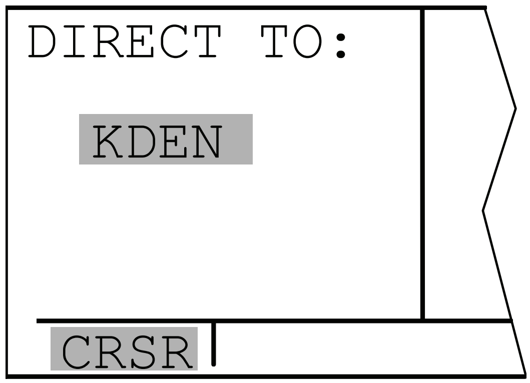


Figure 3D-8. Direct To Page

If the flight plan 0 page is displayed on the left side and the cursor is over one of the waypoint identifiers in flight plan 0 when the **D→** button is pressed, that waypoint identifier will display on the Direct To page.

If the KLN 90B is displaying the Super NAV 5 page and the right inner knob is in the out position, the waypoint highlighted in the lower right hand corner of the Super NAV 5 display will be the default waypoint.

If condition number 1 or 2 isn't occurring:

If there is any waypoint page (APT 1-8, VOR, NDB, INT, SUP, or ACT page) in view on the right side when the **D→** button is pressed, the Direct To page will contain the identifier of the waypoint being viewed on the right side.

If none of conditions number 1, number 2, or number 3 above are occurring, then:

When the **D→** button is pressed, the waypoint identifier for the current active waypoint will be displayed. However, if the active waypoint is the missed approach point and the aircraft is passed the missed approach point, the KLN 90B will display the first waypoint of the missed approach procedure on the Direct To page.

If there is no active waypoint when the **D→** button is pressed, the Direct To page displays blanks. In order for there not to be an active waypoint, there is no direct to waypoint and there are no waypoints in flight plan 0.

Direct To – Procedure 1.

Press the **D→** button. The Direct To page is displayed on the left side. The cursor will already be on the left page. A waypoint identifier may or may not be displayed.

Rotate the left inner knob to select the first character of the desired waypoint's identifier.

Rotate the left outer knob one step clockwise to move the flashing portion of the cursor over the second character position.

Rotate the left inner knob to select the second character of the identifier.

Use the left outer and inner knobs as in the previous steps until the desired is completely displayed.

Press the **ENT** button to display the waypoint page on the right side for the selected waypoint. If an incorrect identifier has been entered, immediately start using the left inner knob to re-enter the correct identifier.

Press the **ENT** button again to approve the displayed waypoint page. The right side will display the NAV 1 page, Figure 3D-9, and the left side will return to page that was displayed prior to pressing the **D→** button. If the direct to was started while the NAV 1 page was shown on the left side, the left and right pages will revert to the pages that were shown before the direct to was started. The selected waypoint is now the active direct to waypoint.

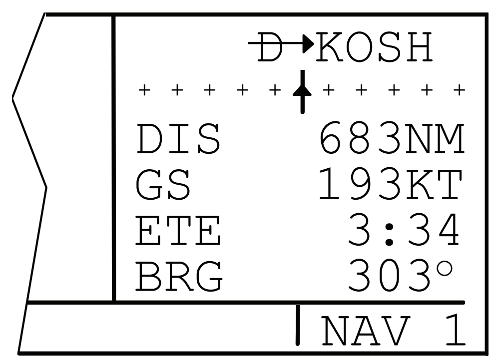


Figure 3D-9. NAV 1 Page (Direct To Operation)

NOTE

In some cases during approach operations, the KLN 90B presents a page asking how a waypoint is used when the waypoint identifier is entered character by character. When this page is presented, simply choose the desired use of the waypoint (e.g., FAF or MAHP) by moving the cursor with the left outer knob and pressing ENT. Choosing correct use of the waypoint is required to ensure proper waypoint sequencing once the aircraft reaches the waypoint.

Direct To – Procedure 2.

Select the desired waypoint page on the right side.

Press the D→ button. The Direct To page is displayed on the left side and it contains the desired waypoint identifier.

Press the **ENT** button to approve the waypoint page displayed on the right side. The right side will now display the NAV 1 page and the left side will return to the page that was displayed prior to pressing the D→ button. If the direct to was started while the NAV 1 page was shown on the left side, the left and right pages will revert to the pages that were shown before the direct to was started. The selected waypoint is now the active direct to waypoint.

Recentering the Deviation Bar. To re-center the deviation bar to proceed to the same waypoint and perform the following:

Select a non-waypoint page (NAV, D/T, REF, or CTR) or the Active Waypoint page on the right side.

Press the **D→** button. The Direct To page is displayed on the left, containing the active waypoint identifier.

Press the **ENT** button.

NOTE

If the KLN 90B is in the approach mode and this method is used to center the deviation bar when the missed approach point is the active waypoint, the approach mode will be canceled and the unit will revert to the approach arm mode. A missed approach will have to be executed.

Proceeding Directly to Another Waypoint. Proceed direct to another waypoint other than the active waypoint, by using Direct To procedure 1 or 2 at any time.

Canceling Direct To Operation. The primary reason for wanting to cancel direct to operation is to return to flight plan operation.

Press the **D→** button.

Press the **CLR** button.

Press the **ENT** button.

Waypoint Alerting for Direct To Operation. Approximately 36 seconds prior to reaching a direct to waypoint, the arrow preceding the waypoint identifier on the waypoint page for the active waypoint will begin flashing. This arrow will also be flashing on any navigation page or any distance/time page displaying the active waypoint identifier. On the Super NAV 5 page, the entire waypoint identifier will start to flash. This is called waypoint alerting. The external waypoint annunciator will begin flashing at the same time.

NAVIGATION PAGES.

The KLN 90B has six navigation pages. Unlike any other pages, these pages may be selected and viewed on both the left and right sides of the screen.

NAV 1 Page. The NAV 1 page, Figure 3D-10, displays the following information.

The Active Navigation Leg. For direct to operation, this consists of →D→ followed by the active DIRECT TO waypoint identifier. For the leg of a flight plan, this consists of the FROM waypoint identifier and the active TO waypoint identifier. An arrow (→) precedes the active waypoint identifier.

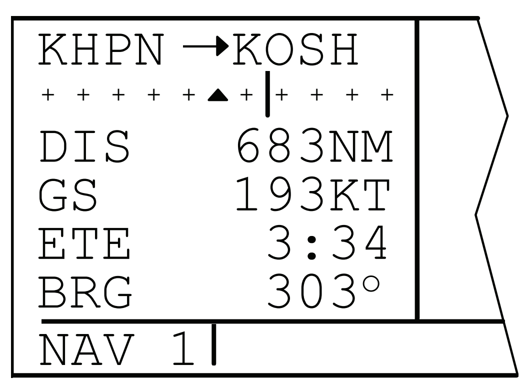


Figure 3D-10. NAV 1 Page (Flight Plan Operation)

A Course Deviation Indicator (CDI) that displays left and right deviation from the desired track. A vertical bar operates like a navigation needle on a conventional CDI or EHSI. Each dot represents one nautical mile deviation from the desired track, five nautical miles full scale deflection. The center triangle also serves as the CDI's TO / FROM indicator. The word FLAG is displayed over the CDI when the KLN 90B is not usable for navigation.

NOTE

It is possible to change the CDI scale factor to be 0.2 NM per dot, 1 nautical mile full-scale deflection, or 0.06 nm per dot, 0.3 nm full scale defection.

The Super NAV 1 Page. When the NAV 1 page is selected on both the left and right sides at the same time, the Super NAV 1 page is displayed. The Super NAV 1 page contains exactly the same information as the standard NAV 1 page but spreads the data across the entire screen making it easier to view.

NAV 2 Page. The NAV 2 page displays the aircraft's present position in two formats. The first format is in terms of the distance and radial from a nearby VOR. The second format is in latitude and longitude.

NAV 3 Page. Refer to Figure 3D-11.

Desired Track (DTK). The great circle course between two waypoints. Any CDI or EHSI driven by the KLN 90B, including the CDI displayed on the NAV 1 page is referenced to this desired track.

NOTE

If the KLN 90B is in the OBS mode, the selected course (OBS) is displayed instead of the desired track.

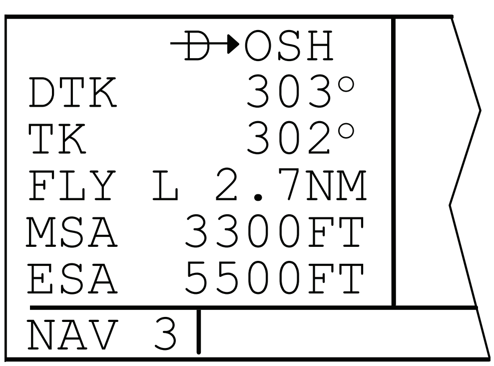


Figure 3D-11. NAV 3 Page

Actual Track (TK). The aircraft's present track over the ground.

Cross Track Error Correction. This is a text means of indicating how far and which direction to get back on course. It is consistent with the vertical deviation bar displayed on the NAV 1 page.

Minimum Safe Altitude (MSA). The MSA displayed is the altitude defined by Jeppesen as Grid Minimum Off-Route Altitude (Grid MORA). This altitude is derived by Jeppesen for sectors that are 1° of latitude by 1° of longitude in size. One degree of latitude is 60 nm. One degree of longitude is 60 nm at the equator and progressively less than 60 nm as one travels away from the equator. One degree of longitude is approximately 50 nm at the southern most parts of the U.S. and is approximately 40 nm at the northern most parts of the U.S. The MSA altitude information is contained in the database and is updated when the database cartridge is updated.

The MSA provides reference point clearance within these 1° latitude by 1° longitude sectors. A reference point is defined as a natural (peak, knoll, hill, etc.) or man-made (tower, stack, tank, building, etc.) object. Grid MORA values clear all reference points by 1000 feet in areas where the highest reference points are 5000 feet MSL or lower. MORA values clear all reference points by 2000 feet in areas where the highest reference points are above 5000 feet MSL. The KLN 90B displays dashes for areas outside the database coverage area or for areas where the Grid MORA is not defined.

WARNING

The MSA and ESA altitudes are advisory in nature only. They should not be relied upon as the sole source of obstacle and terrain clearance. Refer to current aeronautical charts for appropriate minimum clearance altitudes.

Minimum En Route Safe Altitude (ESA). When the KLN 90B is in the LEG mode, the ESA is the highest MSA from the present position to the active waypoint, to the destination waypoint via the active flight plan. When the KLN 90B is in the OBS mode, the ESA is the highest MSA from the present position to the active waypoint. Refer to Figure 3D-12.

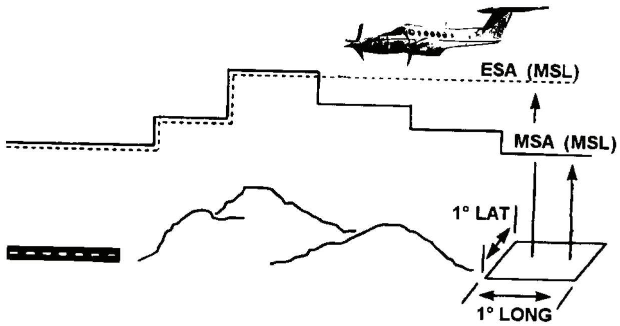


Figure 3D-12. Minimum En Route Safe Altitude

NAV 4 Page. The NAV 4 page is used for altitude alerting and for advisory vertical navigation. Refer to Figure 3D-13.

```
 ALTITUDE        VNV INACTV

BARO:30.09"     IND 09000FT
ALERT: ON →     SEL:04000FT
WARN:±300FT     KMKC :-00NM
                ANGLE:-0.0°
 CRSR ENR - LEG       CRSR
```

Figure 3D-13. Altitude Page and NAV 4 Page

Altitude alerting allows the selection of a target altitude and then provides a visual alarm 1000 feet prior to reaching the selected altitude, another upon reaching the altitude and another for deviation from the selected altitude.

Press the altitude button. The altitude page will be displayed on the left with the cursor over the first two digits of the barometric altimeter setting. The NAV 4 page will be displayed on the right with the cursor over the first digit of the selected altitude field.

Use the left knobs to update the altimeter setting if required. There are three cursor positions. Use the left outer knob to move the cursor and the left inner knob to change the digits. With the proper altimeter setting, the indicated altitude on the right should be the same as the aircraft's actual altimeter.

NOTE

There may be some difference (less than 100 feet) between the indicated altitude and the aircraft's actual altitude if the altitude input to the KLN 90B is from an altitude encoder because these encoders only provide altitude in 100 foot increments.

Turn the left outer knob one step clockwise to position the cursor over the ALERT field. If OFF is displayed, turn the left inner knob to select **ON**. When alerting is enabled, an arrow to the right of ON points to the selected altitude on then right side of the screen.

Select an amount of warning by using the left outer knob to position the cursor over the WARN field and using the left inner knob to select the amount of warning. It is selectable in 100-foot increments from 200 feet to 900 feet.

Enter the selected altitude one digit at a time in the SEL field of the NAV 4 page by using the right outer knob to position the cursor over the desired digit and the right inner knob to change the digits.

Press altitude to return to the pages previously displayed.

CAUTION

The altitude-alerting feature will only be accurate if the barometric altimeter setting is kept updated.

NOTE

Due to the resolution of the altitude input, it may be necessary to descend slightly below or climb slightly above the selected altitude before the reaching altitude alert is activated. This selected altitude alert must be activated to arm the system for providing the altitude deviation alert.

The altitude alert annunciator will flash three times 1,000 feet prior to reaching the selected altitude, flash twice upon reaching the selected altitude, and flash four times when deviating above or below the selected altitude by more than the warning selected. Additionally, the altitude-alerting feature is interfaced with the GPAAS in aircraft that do not have an altitude pre-selector. The GPAAS will announce "Altitude, Altitude" in the above three situations. In those aircraft with an altitude pre-selector, altitude alerting is incorporated with that system.

The KLN 90B has a Vertical Navigation (VNAV) feature that allows an ascent or descent path to be programmed and then provides advisory altitudes to fly to arrive at a waypoint at a specified altitude. The NAV 4 page is used to program vertical navigation.

Select the NAV 4 page on either side of the screen. The NAV 4 page can be selected either by using the outer and inner knobs or by pressing the altitude button to bring up the NAV 4 page on the right and the Altitude page on the right.

The identifier for the active waypoint is automatically displayed on the NAV 4 page. Prior to programming a VNAV operation, the top of the page displays VNV INACTV.

Press the appropriate **CRSR** button to turn on the cursor function if it is not already on.

Enter the desired altitude in the SEL field.

Using the outer knob, move the cursor to the offset field adjacent to the active waypoint identifier. Entering an offset allows reaching the desired altitude a specified distance before reaching the waypoint.

Notice that the bottom of the NAV 4 page now displays an angle. To start the descent now using the displayed descent angle, use the outer knob to position the cursor over the ANGLE field. VNAV operation is initiated by bringing the cursor over the ANGLE field. By leaving the cursor off of the ANGLE field, the angle will increase as flight is continued toward the waypoint. When the desired angle is reached, position the cursor over the ANGLE field and VNAV will commence. When VNAV begins, the top of the page displays an advisory altitude.

A desired angle may be programmed. The CAL 4 page may be used to calculate a descent angle. To program a descent angle:

q. Using the outer knob, move the cursor to the ANGLE field and enter the desired descent angle. If the time to begin the descent is greater than 10 minutes, VNV ARMED will be displayed on the top line of the NAV 4 page. If the time is less than 10 minutes, the top line displays a countdown to the time to begin descent.

(30) Return to any desired page for now. If the NAV 4 page was selected by pressing the altitude button, press the altitude button once again to return to the pages previously in view. If the NAV 4 page was selected by using the outer and inner knobs, insure the cursor function is off and use the outer and inner knobs to select the desired page. Approximately 90-seconds before the time to begin the descent, the message prompt will flash. The message page will display VNAV ALERT. This is notification to view the NAV 4 page because it is getting close to the time to begin the descent.

(31) When the countdown reaches 0:00, the time will be replaced with an altitude advisory. Begin the descent so that the altitude displayed on the altimeter matches the altitude advisory.

VNAV on a flight plan is virtually identical. The NAV 4 page will initially contain the identifier for the active waypoint. VNAV may be programmed referencing this waypoint or any waypoint in the active flight plan that is still in front of the aircraft's position. When another valid waypoint in the flight plan is entered on the NAV 4 page, the aircraft's lateral flight path is not altered.

NAV 5 Page. The NAV 5 page provides a navigation graphics presentation. Refer to Figure 3D-14.

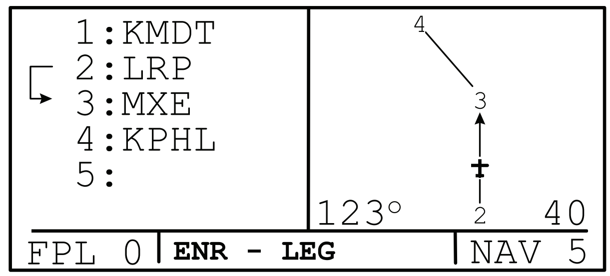


Figure 3D-14. NAV 5 Page

In all KLN 90B installations, there are three common map orientations that may be selected on the NAV 5 page: a true north up display, a desired track up display, or an actual track up display. In addition, if the KLN 90B is interfaced with the engine trend monitoring system, a heading up presentation may also be selected.

CAUTION

When using the actual track up format, it is typical for there to be a slight delay from the time a heading change is made until the correct map orientation is displayed. Do not confuse the desired track up display or the actual track up display with the heading up display.

When navigating using flight plan operation, the active flight plan (FPL 0) waypoints are displayed using the number associated with the waypoint as it appears on the FPL 0 page. An arrow points to the active waypoint and shows the current flight plan leg. When operating direct to a waypoint that is not in the active flight plan, the direct to waypoint is indicated with an asterisk. Refer to Figure 3D-15.

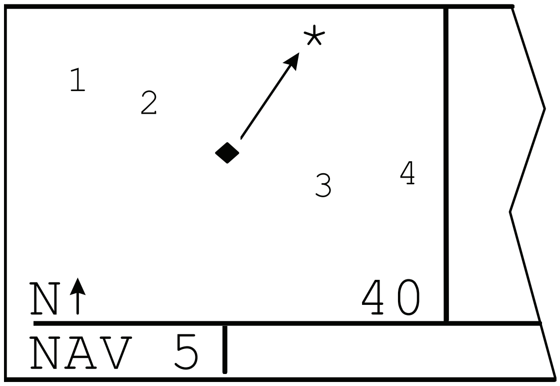


Figure 3D-15. Nav 5 Page (Flight Plan Operation)

To select the desired NAV 5 orientation, press the appropriate **CRSR** button. The cursor will be over the map range scale. Turn the appropriate outer knob one step counterclockwise to position the cursor over the map orientation field. Rotate the appropriate inner knob to display **N↑** for north up, **DTK↑** for desired track up, **TK↑** for actual track up, or **HDG↑** for heading up. If the cursor is moved to the map range scale using the outer knob or if the cursor is turned off with the **CRSR** button, the **DTK↑**, **TK↑**, or **HDG↑** annunciation is replaced with the actual value. In the North up format and the desired track up format, the aircraft's position is depicted by a diamond. In the actual track up and heading up format, the aircraft's position is depicted by an aircraft symbol.

The range scale is displayed in the right corner of the NAV 5 page. The range scale indicates the distance from the aircraft's position to the top of the screen. Range scale selections from 1 nm to 1000 nm may be made by pressing the appropriate **CRSR** button and turning the appropriate inner knob.

When the NAV 5 page is displayed on the left side of the screen and any selected waypoint page is displayed on the right side, the location of the selected waypoint is indicated by a "+" on the NAV 5 page. The display scale must be chosen which allows the selected waypoint to be displayed.

The Super NAV 5 Page. The Super NAV 5 page provides a moving map display of the present position and route of flight in relation to nearby navaids and airports. This page is displayed by selecting the NAV 5 page on both sides of the screen at the same time. The Super NAV 5 page has a unique format. There are no page display indicators in the lower left and right segments of the display. The mode annunciation is located on the far-left side. The message prompt will appear in the lower left corner of the graphics display. Refer to Figure 3D-16.

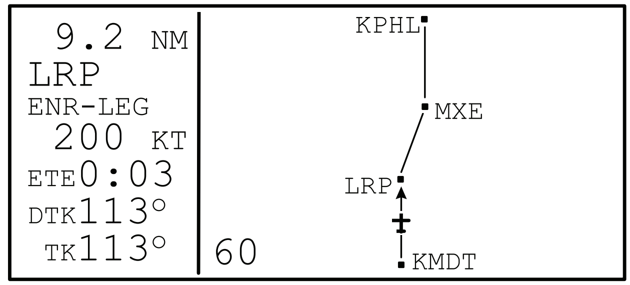


Figure 3D-16. Super NAV 5 Page

The left side of the Super NAV 5 page shows the following information:

Distance to the active waypoint

The active waypoint identifier

Mode of operation

Groundspeed

Estimated time en route, cross-track error, or VNAV status as selected by the pilot

Desired track, bearing to the active waypoint, or radial from the active waypoint as selected by the pilot

Actual track, bearing to the active waypoint, or radial from the active waypoint as selected by the pilot

Make the selection in 4, 5, and 6 above by pressing the left **CRSR** button and rotating the left outer knob counterclockwise until it is over the desired line. Then turn the left inner knob to choose between the items for a given line. When all selections are complete, turn off the cursor by pressing the left **CRSR** button.

The map scale is also changed by using the left **CRSR** button. To change the map scale, press the left **CRSR** button to place the cursor over the map scale at the bottom left corner of the map display. The map scale choices are the same as for the NAV 5 page except there is an additional choice, AUTO, that is located between the 1 and 1000 nm scale factors. The AUTO scale factor will automatically choose the smallest map scale that will display the active waypoint and, if there is one, the waypoint after the active waypoint. While taxing on the airport or flying the traffic pattern, select the 1 nm or 2 nm scale to display the airport diagram. All runway designations are shown on the 1 nm scale. Only the longest runway designation is shown on the 2 nm scale.

NOTE

The track up graphics presentation can only be displayed if the aircraft is moving at least 2 knots. The heading up or North up display may be necessary if there is little or no movement.

Like the NAV 5 page, the Super NAV 5 page shows a graphic depiction of the direct to waypoint or the waypoints making up the active flight plan. The Super NAV 5 page, however, shows waypoint identifiers. Nearby VOR's, NDB's, and airports may be added to the graphics display. Refer to Figure 3D-17. To do so, press the right **CRSR** button to display a pop up menu on the right side of the screen. Notice from the menu that a circle with a dot in the center represents a VOR, a smaller circle represents an NDB, and a small diamond represents an airport. The VOR's, NDB's, and airports displayed are those from the nearest waypoint lists.

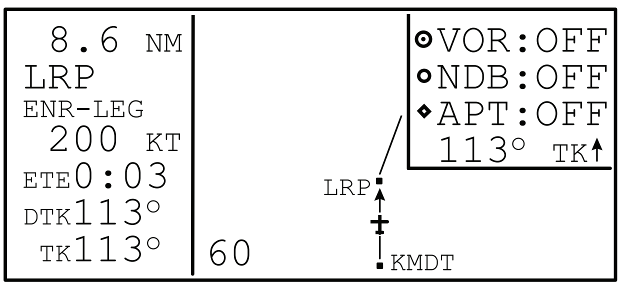


Figure 3D-17. Super NAV 5 Page (Waypoint Identifiers)

NOTE

In some parts of the world, VOR's are not classified into one of the three standard classes, therefore, TLH must be selected to display these undefined class VOR's.

When the menu is first displayed, the cursor will be on the VOR selection field. Rotate the right inner knob to display TLH, LH, H, or OFF. With TLH selected, terminal, low altitude, and high altitude VOR's are selected. In addition, VOR's of undefined class will be displayed.

If LH is selected, only low altitude and high altitude VOR's will be displayed. With H selected, only high altitude VOR's will be displayed. With OFF selected, no VOR's are displayed.

NDB's and/or airports may be selected by first using the right outer knob over the NDB or APT selection field and then using the right inner knob to select **ON** or **OFF**.

The map orientation can be changed by moving the cursor to the bottom line of the pop up menu and rotating the right inner knob. The map orientation choices are the same as for the NAV 5 page.

When the desired selections have been made, press the right **CRSR** button to remove the menu.

It is easy to clutter the display. Select a range scale that allows an uncluttered presentation. Or, select a less cluttered combination of VOR's, NDB's, and airports. Press the clear button to de-clutter the graphics display.

CAUTION

The NAV 5 and Super NAV 5 pages do not display weather, terrain, special use airspace, or other data.

It is possible to change the active waypoint to any of the flight plan waypoints on this page. Pull the right inner knob to the out position. This will create a window at the bottom right corner of the display that will initially contain the identifier of the active waypoint. Refer to Figure 3D-18. The waypoint contained in this window will be the default waypoint when the direct to button is pressed. By turning the right inner knob, it is possible to scan through the waypoints of the active flight plan. Turning the knob clockwise will scan through the waypoints in sequence until the end of the flight plan is reached. Turning the knob counterclockwise will scan through the active flight plan in reverse order until the beginning of the flight plan is reached. Pushing the right inner knob in will remove the window from the display.

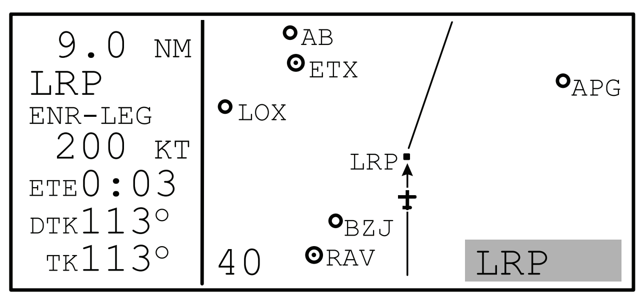


Figure 3D-18. Super NAV 5 Page (Active Waypoint Identifiers)

The Super NAV 5 page can be configured to display the VNAV status. This means the VNAV status and advisory altitude for VNAV can be displayed on the Super NAV 5 page. The VNAV problem still needs to be set up on the NAV 4 page.

CAUTION

Advisory VNAV operation will only be accurate if the barometric altimeter setting is kept updated.

Set up the VNAV situation from the NAV 4 page.

Turn to the Super NAV 5 page by selecting NAV 5 on both sides of the display.

Turn on the left cursor and rotate the left outer knob counter-clockwise until the cursor is over the third line from the bottom of the display.

Rotate the left inner knob until VNAV is displayed. Turn the left cursor off.

The Super NAV 5 page will now display the VNAV status. If the VNAV problem has not been defined yet, V OFF will be displayed. If the time to start VNAV operation is greater than 10 minutes, V ARM is displayed. When the time to VNAV operation is less than 10 minutes, the time until VNAV operation will start will be displayed, e. g., V 4:53. If the VNAV operation has started, a suggested altitude will be displayed, e. g., V 4300.

CAUTION

Failure to keep the barometric altimeter setting updated will result in inaccurate special use airspace alerting.

The KLN 90B's special use airspace alert is only a tool to assist the pilot and should never be relied upon as the sole means of avoiding these areas.

NOTE

Special use airspace alerting is disabled when in the approach arm or approach active modes.

SPECIAL USE AIRSPACE ALERT.

The KLN 90B contains the location of areas of special use airspace. A message prompt is used to alert proximity to special use airspace. When the message page is viewed, it will display AIRSPACE ALERT and the name and type of the special use airspace. If the special use airspace is a Class B, Class C, CTA, or TMA, the message page will include instructions to see the APT 4 page for the primary airport for the correct communications frequency.

The special use airspace alert feature is three-dimensional. The areas are stored in the database with regard to altitude when the actual altitude limitations are charted in terms of Mean Sea Level (MSL). Therefore, for flight above or below an area of special use airspace, there will be no alert. If the actual lower limit is charted in terms of an Altitude Above Ground Level (AGL), it is stored in the KLN 90B as all altitudes below the upper limit. If the actual upper limit is charted in terms of AGL, it is stored in the KLN 90B as unlimited.

The types of areas stored in the database and the abbreviations used to denote these areas are detailed in Table 3D-4.

Only the outer lateral boundaries are stored for Class B, Class C, CTA, and TMA airspace. These special use airspace areas are stored as cylinders of airspace so all altitudes below the upper limit of these areas are considered to be in the area.

Table 3D-4. Special Use Airspace

DISPLAY	EXPLANATION
ALRT	Alert Area
CAUT	Caution Area
CL B	Class B
CL C	Class C
CTA	Control Area (outside the USA)
DNGR	Danger Area
MOA	Military Operations Area
PROH	Prohibited Area
REST	Restricted Area
TMA	Terminal Area (outside the USA)
TRNG	Training Area
WARN	Warning Area

The message prompt for a special use airspace alert will occur when the aircraft is approximately 10 minutes from penetrating the outer boundary. It will also occur if the aircraft is within approximately 2 nautical miles of one of these areas even if the aircraft won't actually penetrate the area. The pilot selects the amount of vertical buffer. If one of the areas is penetrated, another message will state, INSIDE SPC USE AIRSPACE.

AIRPORT PAGES.

There are eight airport pages for every airport in the published database.

The database primary area contains public use and military airports that have a runway at least 1000 feet in length.

Airport 1 Page. Refer to Figure 3D-19.

NOTE

The APT 1 page has a different format when it is displayed as one of the nine nearest airports.

Airport identifier. An arrow precedes the identifier if the airport is the active waypoint.

Airport name.

If the airport underlies the outer boundary of Class B or C airspace, CTA, or TMA, the letters CL B, CL C, CTA, or TMA will display. If the airport is military, the letters MILTRY will display.

The latitude and longitude of the airport reference point.

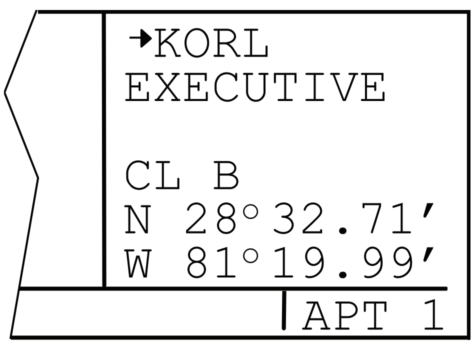


Figure 3D-19. APT 1 Page

Airport 2 Page. Refer to Figure 3D-20.

Airport identifier. An arrow precedes the identifier if it is the active waypoint.

The city where the airport is located.

The state if the airport is located in the United States, the province if in Canada, or the country outside of the United States and Canada.

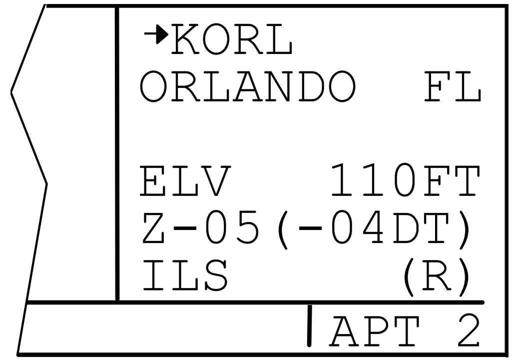


Figure 3D-20. APT 2 Page

Airport Elevation. The elevation is rounded to the nearest 10 feet.

Time in relationship to UTC (Zulu). Z-05, for example, indicates local standard time is 5 hours behind UTC time. If the airport is located in an area which observes daylight savings time, the information in parentheses shows the daylight savings time in relation to UTC.

Instrument Approach Information. Refer to Table 3D-5 for the various displays and their explanations.

Table 3D-5. Instrument Approach Information

DISPLAY	EXPLANATION
ILS	Airport has an ILS approach.
ILS/MLS	Airport has ILS and MLS approaches.
MLS	Airport has an MLS approach.
NO APR	Airport does not have an instrument approach.
NP APR	Airport has a non-precision approach and no ILS or MLS.

The symbol (R) designates that the airport is serviced by an Approach/Departure control facility having radar capability.

Airport 3 Page. Refer to Figure 3D-21. The function of the APT 3 page is to display runway information for the selected airport. For many airports the first APT 3 page depicts a North up runway diagram.

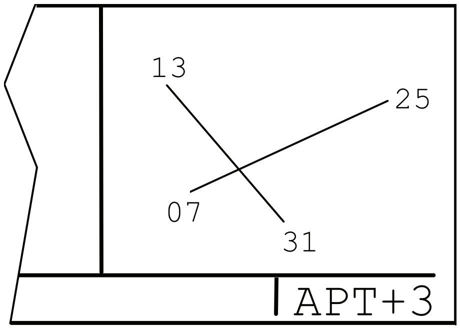


Figure 3D-21. APT 3 Page

The primary APT 3 page follows the runway diagram. Runway designation, lighting, and types of surface for up to five runways are displayed in order of length, beginning with the longest. Many times all of the data does not fit on one page. A "+" inserted between the page type and the number indicates more than one of that page. Refer to Figure 3D-22.

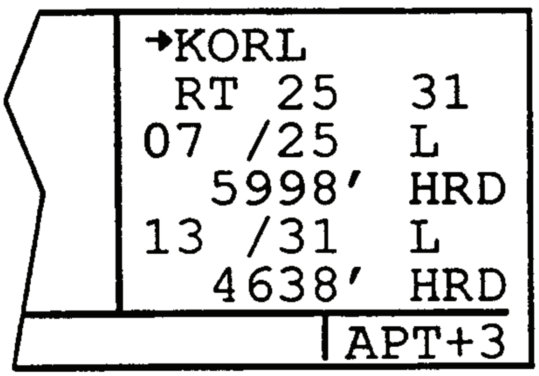


Figure 3D-22. Primary Airport 3 Page

The letters RT followed by a runway designation indicate that the runway normally has a right hand traffic pattern.

Runway designation for both ends of the runway.

Runway Lighting Availability. Refer to Table 3D-6 for displays and explanations.

Table 3D-6. Runway Lighting

DISPLAY	EXPLANATION
L	Runway lighting sunset to sunrise.
LPC	Runway lighting is pilot controlled.
LPT	Runway lighting is part-time or on request.
Blank	Blank indicates no lighting.

Runway Length in Feet.

Runway Surface. Refer to Table 3D-7 for runway surface displays and their explanations.

In the event that there is no runway information for an airport, RUNWAY DATA NOT AVAILABLE is displayed on the APT 3 page.

Airport 4 Page. The APT 4 page is used to display communication frequencies. Refer to Figure 3D-23.

Airport Identifier. An arrow precedes the identifier if it is the active waypoint.

Table 3D-7. Runway Surface

DISPLAY	EXPLANATION
Blank	Blank indicates runway surface unknown.
CLY	Clay
DRT	Dirt
GRV	Gravel
HRD	Hard surface (includes asphalt, concrete, pavement, sealed, tarmac, brick, and bitumen)
ICE	Ice
MAT	Steel Matting
SHL	Shale
SND	Sand
SNW	Snow
TRF	Turf

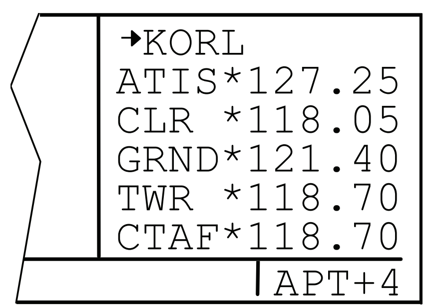


Figure 3D-23. APT 4 Page

Frequencies. Refer to Table 3D-8 for frequency abbreviations and their explanations.

In addition to the standard VHF frequencies, HF frequencies are shown at airports that utilize HF communications in the 2000 kHz to 30,000 kHz frequency band. Airports that have numerous communication frequencies will have multiple APT 4 pages, indicated by APT+4. Part-time operation is indicated with an asterisk to the left of the frequency. Refer to Figure 3D-24.

Frequencies associated with CL B, CL C, TRSA, CTA, or TMA are VFR frequencies. Airports that have one of these categories of frequencies also have APR and DEP which are IFR frequencies. Where required, APR, DEP, CL B, CL C, TRSA, CTA, and TMA frequencies are sectorized. The format for showing the sectorization is to show the frequency first, followed by the identifier of the associated reference point, followed next by the applicable radials, and, finally, the associated altitude restrictions.

Table 3D-8. Frequency Abbreviations

Table 3D-8. Frequency Abbreviations

DISPLAY	EXPLANATION
AAS	Aeronautical Advisory Service
AFIS	Aerodrome Flight Information Service
APR	Approach Control
ARVL	Arrival
ATF	Aerodrome Traffic Frequency
ATIS	Automatic Terminal Information Service
AWOS	Automatic Weather Observing Station
CL B	Class B (VFR Frequency)
CL C	Class C (VFR Frequency)
CLR	Clearance Delivery
CTA	Control Area (VFR Frequency)
CTAF	Common Traffic Advisory Frequency
CTR	Center (When Center Is Used For Approach/Departure Control)
DEP	Departure Control
DIR	Director (Approach Control/Radar)
GRND	Ground Control
MCOM	Multicom
MF	Mandatory Frequency
PCL	Pilot controlled lighting
PTAX	Pre-Taxi Clearance
RAMP	Ramp/Taxi Control
RDO	Radio
RDR	Radar Only Frequency
TMA	Terminal Area (VFR Frequency)
TRSA	Terminal Radar Service Area (VFR Frequency)
TWR	Tower
UNIC	Unicom

NOTE

When an altitude restriction is shown on the APT 4 page, the abbreviation BEL means at and below the specified altitude. The abbreviation ABV means at and above the specified altitude.

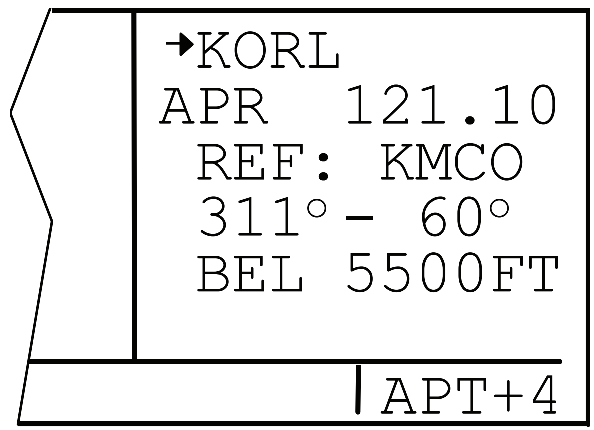


Figure 3D-24. APT 4 Page (BEL)

In a few cases, APR, DEP, CL B, CL C, TRSA, CTA, and TMA frequencies are sectorized such that the restriction cannot be displayed on a single page. When this occurs, TEXT OF FREQUENCY USAGE NOT DISPLAYED is displayed on the APT 4 page. There are some airports in the database for which no communications information is available. In this case, COMM FREQ DATA NOT AVAIL is displayed.

Airport 5 Page. The APT 5 page is used to store and display user entered remarks. These remarks might include information on lodging, dining, airport services, etc. Up to 100 airports may contain these remarks. A remark may contain up to 3 lines of 11 characters each. Letters, numbers, hyphens, and spaces may be used in the remark.

Select the APT 5 page for the desired airport.

Press the right **CRSR** button.

Rotate the right outer knob until the cursor fills the entire third line of the screen.

Use the right inner knob to select the first character of the remark.

Turn the right outer knob one step clockwise to move the flashing portion of the cursor to the second cursor position and use the right inner knob to select the second character.

Use the right outer and inner knobs to select the rest of the first line of the remark.

Press the **ENT** button to approve the first line. The cursor will move to the second line.

Use the above procedure to select the characters of the second and third lines of the remark. Press the **ENT** button to individually approve each line of the remark.

Press the right **CRSR** button to turn the right cursor function off.

Airport 6 Page. The APT 6 page shows aeronautical services available for the selected airport. These services include customs, fuel, and oxygen availability as well as an indicator of a landing fee.

Customs Information. Refer to Table 3D-9 for customs displays and their explanations.

Table 3D-9. Customs Information

DISPLAY	EXPLANATION
Blank	Blank line indicates that customs information is not available in the database.
CUSTMS-ADCS	Customs are available for private aircraft arriving to the U.S. from Canada or Mexico. Advance notice of arrival to customs officers is to be included in the flight plan transmitted to a FAA facility. This code is used when this is the only type customs facility available.
CUSTMS-PR	Customs facilities are available but require prior request or permission for use.
CUSTMS-REST	Customs facilities are available on a restricted basis, check with airport before planning to use.
CUSTOMS-FULL	Customs facilities are available without restriction.
NO CUSTOMS	No customs facilities are available.

Table 3D-9. Customs Information

Fuel Types. Refer to Table 3D-10 for fuel types displays and their explanations.

Table 3D-10. Fuel Types

DISPLAY	EXPLANATION
MOGAS	Automotive Fuel
JET	Jet Fuel (Any Type Qualifies)
NO FUEL	No Fuel Available
80	80 Octane
100	100 Octane
100LL	100 Octane, Low-Lead

If there are no oxygen services available at the selected airport, the fifth line will display, NO OXYGEN. If any type of oxygen is available, the fifth line will read OX and the rest of the line will display the specific oxygen service. Refer to Table 3D-11.

Table 3D-11. Oxygen Services

DISPLAY	EXPLANATION
ALL	All Oxygen Services Are Available
H	High Pressure
HB	High Pressure Bottled
L	Low Pressure
LB	Low Pressure Bottled

The sixth line of the APT 6 page denotes a landing fee. Refer to Table 3D-12 for landing fee explanations.

Table 3D-12. Landing Fee Information

DISPLAY	EXPLANATION
LANDING FEE	The airport has a landing fee.
NO FEE INFO	No information on whether

	or not there is a landing fee for this airport.
NO LDG FEE	The airport does not have a landing fee.

Airport 7 Page. The APT 7 page shows the SID and STAR procedures that are available for the selected airport. If both SID and STAR procedures are available, there will be two APT 7 pages indicated by APT+7. If there are no SID or STAR procedures in the database, this page will display, NO SID / STAR FOR THIS AIRPORT IN DATABASE. Use of SID's and STARS will be addressed after flight plans are presented.

Airport 8 Page. The APT 8 page shows the non-precision approaches that are available for the selected airport. If there are no approaches for this airport in the database, this page will display, NO APPROACH FOR THIS AIRPORT IN DATABASE. Use of approaches will be addressed after flight plans are presented.

VOR PAGE.

VOR Page Display. Refer to Figure 3D-25.

VOR Identifier. An arrow precedes the identifier if it is the active waypoint.

The letter D displays following the VOR identifier if the VOR has DME capability.

The name of the VOR.

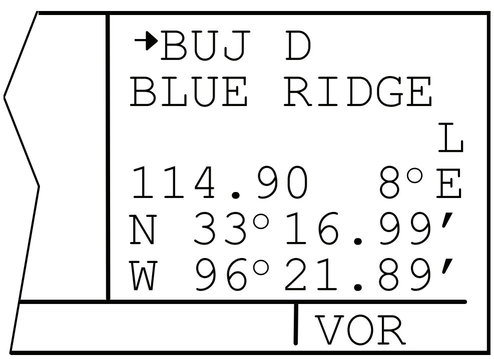


Figure 3D-25. VOR Page

The class of the VOR. Refer to Table 3D-13 for VOR classifications.

Table 3D-13. VOR Classification

DISPLAY	EXPLANATION
H	High Altitude
L	Low Altitude
T	Terminal
U	Undefined

The VOR frequency.

The published magnetic variation of the VOR.

The latitude and longitude of the VOR.

The nine VOR's nearest to the aircraft's present position may be displayed. When a VOR page is displayed as part of the nearest VOR list, the latitude and longitude is replaced with the bearing and distance to the VOR.

NOTE

NDB's which are combined with outer markers (compass locators) are usually not stored with NDB's. However, they are always stored with intersections and are found on the INT page by using the outer compass locator name, not the NDB identifier. There is also a nearest NDB list. When an NDB page is displayed as one of the nearest NDB's, the latitude and longitude are replaced with the bearing and distance to the NDB.

NDB PAGE.

NDB Page Display. Refer to Figure 3D-26.

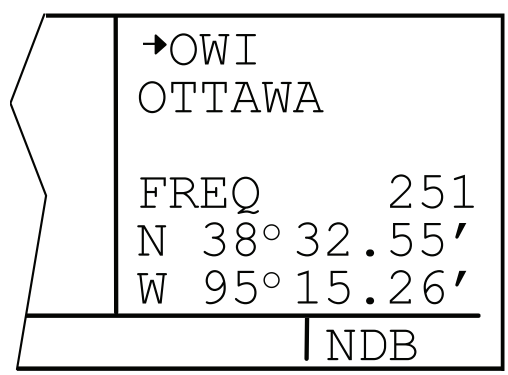


Figure 3D-26. NDB Page

The NDB identifier. An arrow precedes the identifier if it is the active waypoint.

The name of the NDB.

The NDB frequency.

The latitude and longitude.

INTERSECTION PAGE.

Intersection Page Display. The intersection pages contain the named low altitude, high altitude, approach, and SID/STAR intersections as well as outer makers and outer compass locators. Refer to Figure 3D-27.

The intersection, outer marker, or outer compass locator name.

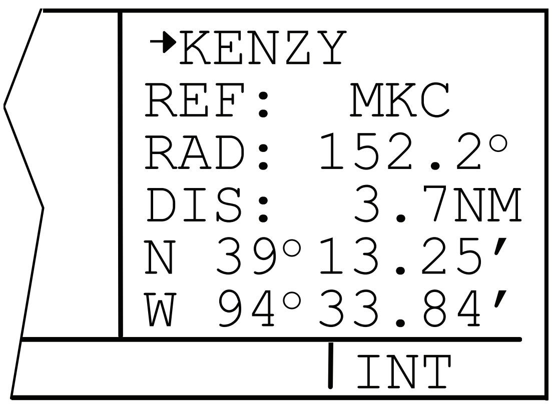


Figure 3D-27. Intersection Page

The location of the intersection, outer marker, or outer compass locator expressed in terms of a radial and distance from a nearby VOR. The KLN 90B chooses the closest VOR. It takes a few seconds for the VOR ident, radial, and distance to be calculated and displayed.

The latitude and longitude of the intersection, outer marker, or outer compass locator. The identifier of another VOR may be entered in the REF field and the page will compute and display the radial and distance from that VOR to the intersection. This information is not stored with the INT page and is lost when leaving the page.

Display the desired intersection page.

Press the right **CRSR** button to turn on the cursor function.

Rotate the right outer knob until the cursor is positioned over the identifier adjacent to REF.

Use the right inner and outer knobs to select the desired identifier.

Press the **ENT** button to display the waypoint page for the identifier just entered.

Press the **ENT** button again to approve the waypoint page. The intersection page is displayed with the computed radial and distance.

Press the right **CRSR** button to turn off the right cursor function.

SUPPLEMENTAL WAYPOINT PAGE.

Supplemental Waypoint Page Display. Supplemental waypoints are user-defined waypoints that have not been defined specifically as an airport, VOR, NDB, or Intersection. Supplemental waypoints also include ARTCC center waypoints and reference waypoints discussed later. The following information is displayed on the supplemental waypoint page.

The name of identifier of the supplemental waypoint.

The position of the supplemental waypoint expressed in terms of a radial and distance from a nearby VOR.

The latitude and longitude of the supplemental waypoint.

The identifier of another nearby waypoint may be entered in the REF field and the page will compute and display the radial and distance from the nearby waypoint to the supplemental waypoint. This radial and distance is not stored with the supplemental waypoint page and is lost when leaving the page.

USER-DEFINED WAYPOINTS.

Up to 250 user-defined waypoints may be created. These waypoints may be defined as a user-defined airport, VOR, NDB, or intersection. If the waypoint doesn’t fit into one of these categories, it may be defined as a supplemental waypoint.

Creating a User-Defined Airport Waypoint. A user-defined airport waypoint must contain an identifier, latitude, and longitude. In addition, any combination of airport elevation, one runway length, and associated runway surface, and remarks can also be stored. Communication frequencies cannot be stored on the APT 4 page, airport services cannot be stored on the APT 6 page, SID's and STAR's cannot be stored on the APT 7 page, and approach procedures cannot be stored on the APT 8 page.

Use the right outer knob to select the airport waypoint pages.

Rotate the right inner knob to select the APT 1 page.

Press the right **CRSR** button to turn on the right cursor function. The cursor will appear over the first character of the identifier.

Use the right inner and outer knobs to select the identifier of the user waypoint. The identifier can be up to four characters in length. Refer to Figure 3D-28.

To create a waypoint at the present position, turn the right outer knob clockwise to position the cursor over PRES POS? and press the **ENT** button. The APT 1 page will now be displayed with the latitude and longitude of the waypoint at the bottom of the page.

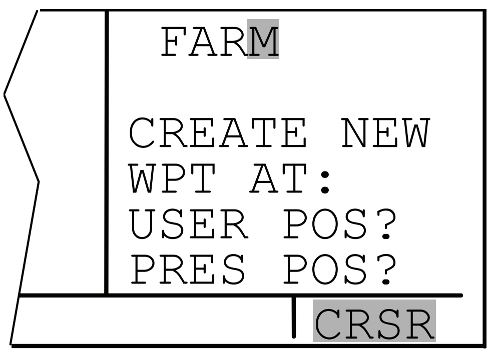


Figure 3D-28. User-Defined Waypoint Page

To create a waypoint at a specified position, place the cursor over USER POS? and press the **ENT** button. A page with the identifier at the top and dashes at the bottom will now be displayed. Refer to Figure 3D-29.

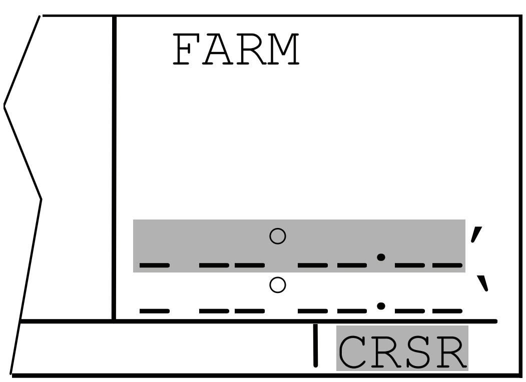


Figure 3D-29. User-Defined Airport Waypoint Page

The cursor will be over the dashed latitude field. The latitude and longitude of the waypoint must be entered. Turn the right inner knob to display an N or an S and select the latitude in degrees, minutes, and hundredths of a minute by using the right inner and outer knobs. When the complete latitude has been selected, press the **ENT** button. The cursor will move down to the longitude field. Turn the right inner knob to select E or W. Use the right inner and outer knobs to select the longitude. Press the **ENT** button to approve the waypoint position.

Turn the right inner knob one step clockwise to display the APT 2 page as illustrated in Figure 3D-30. To enter an airport elevation, press the right **CRSR** button and rotate the right outer knob to position the cursor over the dashes to the right of ELV. Use the right inner and outer knobs to enter the elevation. Press the **ENT** button to store the elevation. Press the right **CRSR** button to turn off the cursor.

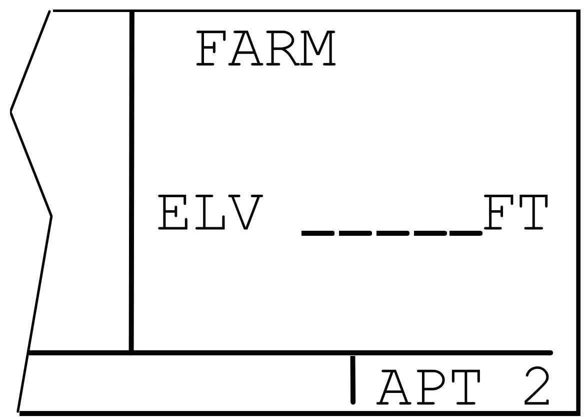


Figure 3D-30. APT 2, User-Defined Airport Waypoint Page

Turn the right inner knob one step clockwise to display the APT 3 page. Refer to Figure 3D-31. To enter a runway length, press the right **CRSR** button and rotate the right outer knob to position the cursor over the five dashes directly beneath RWY LEN. Use the right inner knob to select each individual digit and the right outer knob to position the cursor until the entire runway length is selected. Press the **ENT** button to approve the runway length. The cursor will move to the surface position. Turn the right inner knob to select either HRD or SFT. Press **ENT** to approve the runway surface. Press the right **CRSR** button to turn off the cursor function.

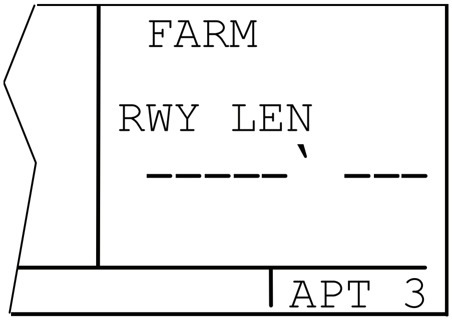


Figure 3D-31. APT 3, User-Defined Airport Waypoint Page

Airport remarks may be stored on the APT 5 page.

Creating a User-Defined VOR Waypoint. A user-defined VOR waypoint must contain an identifier, magnetic variation, latitude, and longitude. The magnetic variation may be manually entered or, if one is not entered, one will automatically be calculated and stored. A VOR frequency may be stored. The procedure for creating a user-defined VOR waypoint is similar to that just described for creating a user-defined airport waypoint. Begin by selecting the VOR waypoint pages. The VOR identifier can be one to three characters in length. A user-defined VOR waypoint page contains the user identifier at the top of the page and three lines of dashes. The top line of dashes may be filled in with frequency and magnetic variation. The second line is for latitude and the third line is for longitude. A user-defined VOR is stored as an Undefined (U) class. Refer to Figure 3D-32.

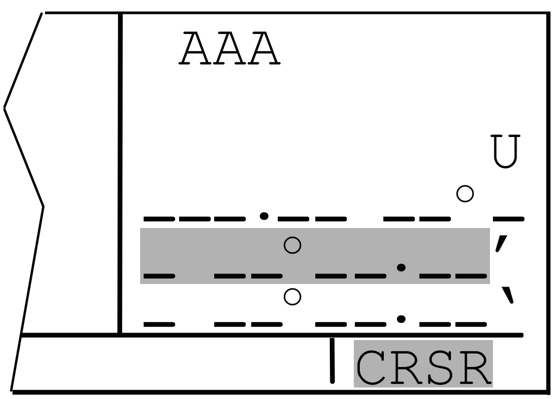


Figure 3D-32. User-Defined VOR Waypoint Page

Creating a User-Defined NDB Waypoint. A user-defined NDB waypoint must contain an identifier, latitude, and longitude. An NDB frequency may be stored. The procedure for creating an NDB user waypoint is similar to that described for creating an airport user waypoint. Begin by selecting the NDB waypoint type pages. The NDB identifier can be one to three characters in length. An NDB user waypoint page contains the user identifier at the top of the page and three lines of dashes. The top line of dashes may be filled in with the NDB frequency. The second line is for latitude and the third line is for longitude. Refer to Figure 3D-33.

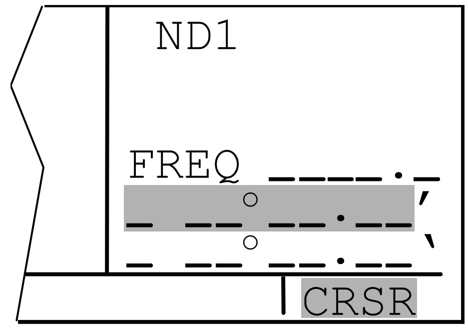


Figure 3D-33. User-Defined NDB Waypoint Page

Creating User-Defined Intersection or Supplemental Waypoints. A user-defined intersection or supplemental waypoint must contain an identifier, latitude, and longitude. The identifier for either can be one to five characters in length. There are two procedures that may be used to define these waypoints. Both procedures begin by selecting the INT or SUP type waypoints, as appropriate.

The first method is similar to that described for creating an airport, VOR, or NDB user waypoint. The second method is to define the waypoint's position in terms of a radial and distance from any other published or previously defined user waypoint.

NOTE

Entering the reference waypoint, radial, and distance is done only to define the waypoint's latitude and longitude position. The reference waypoint, radial and, distance are not stored as part of the user waypoint. As soon as another page is viewed on the right side, these parameters are lost. If a waypoint page for a user-defined intersection or supplemental waypoint is viewed later on, it will display the radial and distance from the VOR nearest the user-defined waypoint. The original reference point may be reentered at any time.

Use the right outer knob to select INT or SUP type waypoints, as appropriate.

Use the right **CRSR** button and the right inner and outer knobs to select a waypoint identifier.

Rotate the right outer knob to position the cursor over USER POS? and press the **ENT** button.

Turn the right outer knob counterclockwise to position the cursor over the dashes to the right of **REF**. Refer to Figure 3D-34.

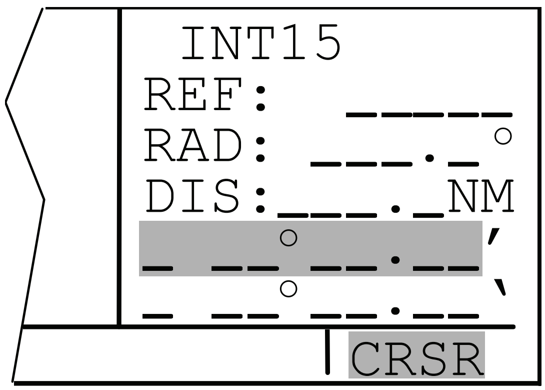


Figure 3D-34. Intersection or Supplemental Waypoint Page

Use the right inner and outer knobs to enter the identifier for the reference waypoint.

Press the **ENT** button to see the waypoint page for the reference waypoint just entered.

Press the **ENT** button again to approve this waypoint page. The waypoint page being created will return with the cursor over the dashes to the right of RAD.

Use the right inner and outer knobs to select the radial from the reference waypoint. The radial may be selected to the nearest tenth of a degree.

Press the **ENT** button. The cursor will move to the dashes to the right of DIS.

Use the right inner and outer knobs to select the distance. The distance may be selected to the nearest tenth of a nautical mile.

Press the **ENT** button. The latitude and longitude are calculated and displayed.

FLIGHT PLANS.

The KLN 90B is capable of storing in its memory 25 flight plans plus an active flight plan. Flight plans are numbered 0 through 25. Each of the flight plans may contain up to 30 waypoints. These waypoints may consist of any combination of published waypoints from the database or user created waypoints.

The active flight plan is always FPL 0. The standard procedure is to create a flight plan in one of the flight plans numbered as 1 through 25. When one of these numbered flight plans is activated, it becomes FPL 0, the active flight plan. If desired, a flight plan may be created directly in the active flight plan. This avoids creating the flight plan in a numbered flight plan and then having to activate it. The disadvantage is the flight plan is not stored and retained for future use. It can, however, be stored.

Modifications may be made to FPL 0 without affecting the way it is stored as a numbered flight plan. Unless direct to operation is being used, the active flight plan must contain at least two points.

Creating Flight Plans.

1. Rotate the left outer knob to select the flight plan type pages. Refer to Figure 3D-35.

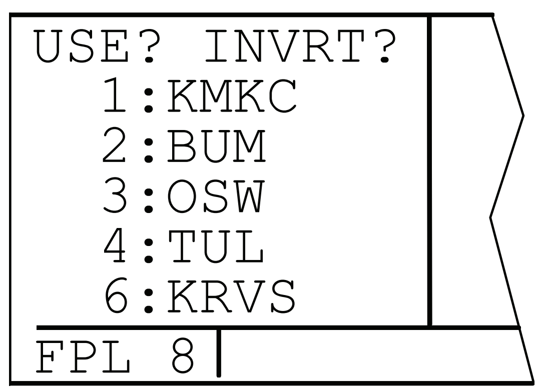


Figure 3D-35. Flight Plan Type Page

Turn the left inner knob to select a flight plan page, preferably other than FPL 0, which does not contain a flight plan as depicted in Figure 3D-36.

Press the left **CRSR** button to turn on the cursor function for the left page.

Use the left inner knob to select the first character of the departure waypoint.

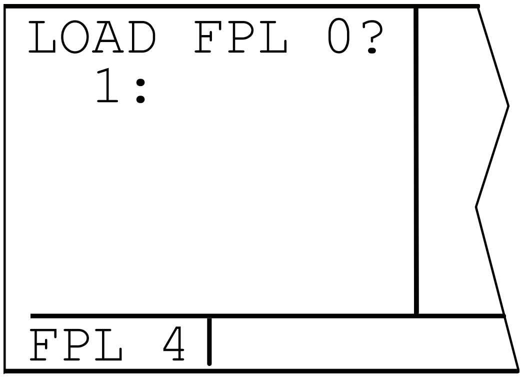


Figure 3D-36. Flight Plan Page

NOTE

The KLN 90B flight plan operation is designed so that the first waypoint in the flight plan should always be the departure point. A four-character identifier, if available, must be used.

Use the left inner and outer knobs to enter the entire identifier.

Press the **ENT** button. A waypoint page for the identifier just entered will be displayed on the right side. Refer to Figure 3D-37. If a mistake was made and the wrong identifier was entered, press the clear button and begin again. If a mistake was not made but the waypoint identifier just entered isn't in the database, a page allowing the creation of a user-defined waypoint will appear on the right side.

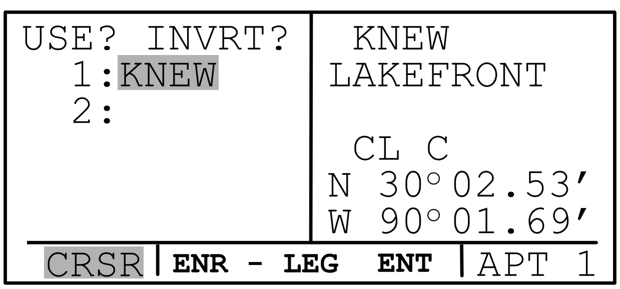


Figure 3D-37. Flight Plan and Waypoint Page

Press the **ENT** button again to approve the waypoint page being displayed. The cursor will move to the second waypoint position. Refer to Figure 3D-38.

NOTE

A small number of waypoints are stored in the database as waypoints that the governing agency has decided it is important to fly directly over instead of using turn anticipation. These waypoints are associated with SID / STAR procedures. In these cases the KLN 90B will present a waypoint type identification page. Simply select the way in which the waypoint is intended to be used with the left outer knob and press the ENT button. If the SID / STAR choice is selected, the KLN 90B will disable turn anticipation for that waypoint, if previously enabled. The KLN 90B will enable turn anticipation after the waypoint has been passed, if turn anticipation was previously enabled. If en route is selected, normal turn anticipation occurs.

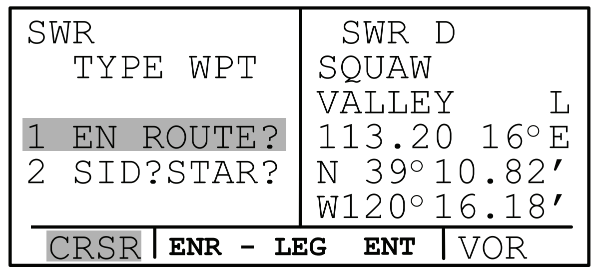


Figure 3D-38. Waypoint Type Identification Page

Use the same procedure to enter the rest of the waypoints in the flight plan. If the flight plan consists of five or more waypoints, the waypoints will automatically scroll as necessary to allow entry of the next waypoint.

When all of the waypoints have been entered in the flight plan, the left outer knob may be rotated to move the cursor up and down and manually scroll through the waypoints making up the flight plan. If the flight plan consists of six or more waypoints, not all of the waypoints can be displayed at one time. When the left outer knob is rotated to the full counterclockwise position, the cursor will be positioned over USE?. If there are more than five waypoints in the flight plan, the first four will be displayed followed by the last waypoint in the flight plan. Rotate the left outer knob to move the cursor and manually scroll through the intermediate waypoints.

Press the left **CRSR** button to turn off the cursor function. Additional flight plans may now be created in the same manner.

Activating a Numbered Flight Plan.

2. Use the left outer knob to select the flight plan type pages.

3. Rotate the left inner knob to select the desired flight plan.

4. Press the left **CRSR** button to enable the left cursor function. The cursor will appear over USE?. If the flight plan has just been created, rotate the left outer knob all the way counterclockwise to position the cursor over USE?.

5. Press the **ENT** button to activate the flight plan in the order shown. To activate the flight plan in inverse order, first waypoint becomes the last and last waypoint becomes the first, rotate the left outer knob one step clockwise to position the cursor over USE? INVRT? before pressing the **ENT** button.

The selected flight plan is now displayed as FPL 0, the active flight plan. Any changes made to FPL 0 will not affect how this flight plan is stored as the numbered flight plan.

Adding a Waypoint to a Flight Plan. A waypoint may be added to any flight plan containing fewer than 30 waypoints.

6. Press the left **CRSR** button to enable the cursor function.

7. Rotate the left outer knob as necessary to position the cursor over the location in the flight plan where the new waypoint is to be added.

8. Use the left inner and outer knobs in the normal manner to enter the waypoint identifier being inserted. The existing waypoint in this position automatically jumps down to the next position.

9. Press the **ENT** button to display the waypoint page on the right side for the identifier just entered.

10. Press the **ENT** button again to approve the waypoint page.

Press the left **CRSR** button to turn off the left cursor function.

Deleting a Waypoint From a Flight Plan.

1. Press the left **CRSR** button to enable the left cursor function.

Rotate the left outer knob to position the cursor over the waypoint to be deleted.

Press the CLR button. The letters DEL will appear to the left of the identifier and a question mark will appear to the right of the identifier. If a mistake was made, press the **CLR** button again. Refer to Figure 3D-39.

Press the **ENT** button and the waypoint will be deleted from the flight plan. The other waypoints in the flight plan will be repositioned.

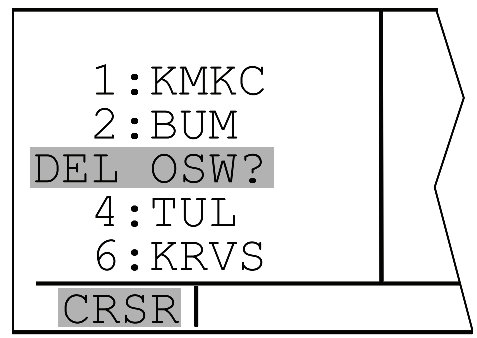


Figure 3D-39. Deleting a Waypoint

Deleting Flight Plans.

2. Display the flight plan that is to be deleted.

3. Make sure the left cursor function is off.

4. Press the **CLR** button. The words DELETE FPL? will appear at the top of the page. Refer to Figure 3D-40. If a mistake was made, press the **CLR** button.

5. Press the **ENT** button to clear the flight plan.

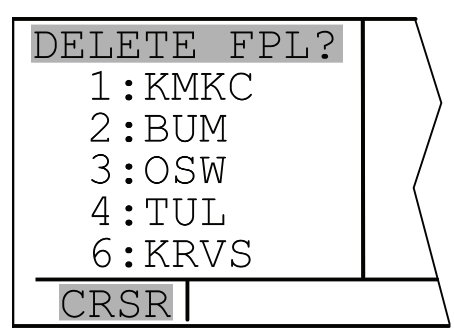


Figure 3D-40. Deleting a Flight Plan

Storing FPL 0 As a Numbered Flight Plan. The active flight plan may be loaded into a numbered flight plan so that it can be recalled for later use.

6. Select a numbered flight plan page that does not contain any waypoints. If none exist, use the procedure for deleting flight plans to clear a flight plan that is no longer required.

Press the left **CRSR** button to turn on the left cursor function. The cursor will come on over the first blank waypoint position.

Rotate the left outer knob one step counterclockwise to position the cursor over LOAD FPL 0. Refer to Figure 3D-41.

Press the **ENT** button to load the active flight plan into this numbered flight plan.

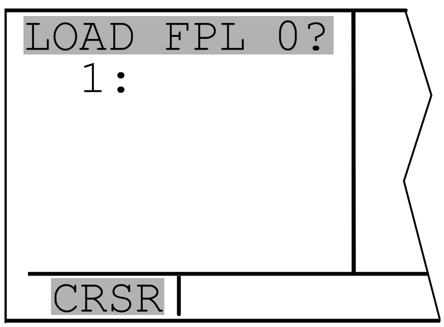


Figure 3D-41. Storing 0 As a Numbered Flight Plan

Operating From the Active Flight Plan. The following rules and considerations apply for flight plan operation while the KLN 90B is in the LEG mode:

Although any of the pages may be utilized while operating along a flight plan, common selections are the FPL 0 page on the left side while simultaneously displaying one of the three Distance/Time pages or the NAV 5 page on the right side. The Super NAV 5 page is especially useful for flight plan operation. It provides a visual orientation of the aircraft position in the active flight plan. The other four NAV pages may also be used extensively.

Always verify that the FPL 0 page is in view.

The active leg of the flight plan is designated with a ↳ symbol. Refer to Figure 3D-42. A leg is defined as the course line between a pair of points. The head of the arrow is positioned to the left of and points to the active TO waypoint. The tail of the symbol points to the FROM waypoint. The symbol is not displayed unless the KLN 90B is receiving signals suitable for navigation or if DIRECT TO navigation is occurring. The top of the NAV 1 page will also indicate if point to point navigation or DIRECT TO navigation is occurring. To cancel the DIRECT TO operation and operate from the active flight plan, press the **D→** button, the clear button, and the **ENT** button.

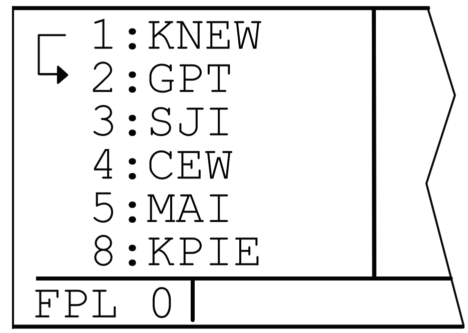


Figure 3D-42. Storing a Flight Plan

As the flight plan waypoints are reached, the active leg symbol automatically orients itself on the next leg.

If the flight plan contains more waypoints than can be displayed on the screen at one time, the page will automatically scroll as progress is made along the flight plan so that the active leg is always displayed.

The last waypoint in the flight plan is always displayed at the bottom of the FPL 0 page, even if all of the waypoints in the flight plan can't be displayed on the page at one time. To view intermediate waypoints, turn the left cursor function on and use the left outer knob manually scroll through all the waypoints. If scrolling is performed all the way to the end of the flight plan, a blank waypoint position will exist so that a waypoint may be added to the end of the flight plan.

Turn Anticipation and Waypoint Alerting. Prior to reaching a waypoint in the active flight plan, the KLN 90B will provide navigation along a curved path segment to ensure a smooth transition between two adjacent legs in the flight plan. Refer to Figure 3D-43. This feature is called turn anticipation. The transition course is based upon the aircraft's actual groundspeed and the amount of course angle change between the two legs. The KLN 90B automatically sequences to the next leg after passing the midpoint in the transition segment.

Approximately 20 seconds prior to the beginning of turn anticipation, the arrow preceding the active waypoint identifier will begin flashing on the FPL 0 page and on any Navigation page, Distance/Time page, or Waypoint page displaying the active waypoint identifier. On the Super NAV 5 page, the entire waypoint identifier will start to flash. The external waypoint alert annunciator will begin flashing at the same time. This is called waypoint alerting.

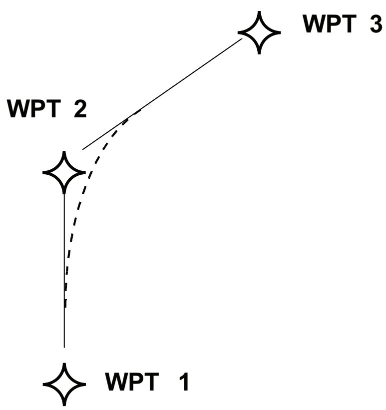


Figure 3D-43. Turn Anticipation

To use the turn anticipation feature, start the turn transitioning to the next leg in the flight plan at the very beginning of turn anticipation. This occurs when the external waypoint alert annunciator or the active waypoint identifier on the Super NAV 5 page stops flashing and goes on steady. The KLN 90B will generate a message on the message page for the new desired track to select on the EHSI: ADJ NAV IND CRS TO 123°. A message will not be given if the change in desired track is less than 5° or the KLN 90B is interfaced with an EHSI having a course pointer that is automatically slewed to the correct desired track.

The desired track displayed on the NAV 3 page also changes to the value of the next leg at the beginning of turn anticipation. Turn anticipation becomes inactive when transition to the next leg has been made.

The KLN 90B can read the selected course set on the external EHSI. The KLN 90B will flash the value of the desired track on both the NAV 3 and the Super NAV 5 pages when the desired track and the selected course differ by more than 10°. Set the selected course to match the desired track. This will ensure that the orientation is always pictorially correct.

If desired, turn anticipation may be disabled, or enabled, on the SET 6 page.

Viewing the Waypoint Pages for the Active Flight Plan Waypoints. The waypoint pages for each of the waypoints in the active flight plan may be displayed by selecting the Active Waypoint page with the right outer knob. Refer to Figure 3D-44. When the ACT page is first selected, the waypoint page for the active waypoint will be displayed. The sequence number of the waypoint in the flight plan is annunciated with a number to the left of the identifier. An arrow to the left of the waypoint number designates the active waypoint. The letter to the far right of the identifier designates the type of waypoint: A – airport, V – VOR, N – NDB, I – intersection, S – supplemental, or T – terminal. For VOR's having DME capability, the letter D is displayed between the VOR identifier and the V.

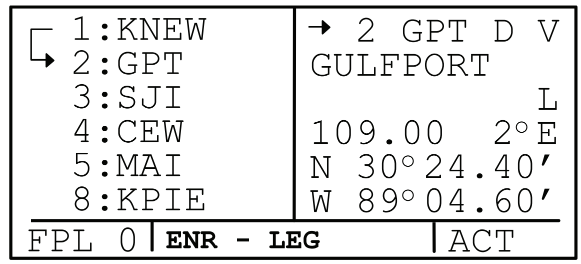


Figure 3D-44. The Active Waypoint Page

To view the other waypoints in the flight plan, pull the right inner knob to the out position and turn it to view each of the waypoints in the order they are in the active flight plan. For airport waypoints, the right inner knob may be pushed back to the in position and rotated to display any of the eight airport pages. Pulling the knob back out will allow further scanning of the waypoint pages in the active flight plan.

Direct To Operation on the Active Flight Plan. When DIRECT TO operation to a waypoint on the active flight plan is selected, the system will provide navigation to the waypoint and then automatically resume navigation along the flight plan when the DIRECT TO waypoint is reached. Waypoints that exist prior to the DIRECT TO waypoint in the active flight plan are bypassed. Navigation on the active flight plan will not be resumed if the DIRECT TO operation is to a waypoint that is not in the active flight plan.

Any of the methods previously described for initiating direct to operation may be used. The following procedure is the easiest for this application.

Select the FPL 0 page on the left side.

Press the left **CRSR** button and then use the left outer knob to position the cursor over the desired waypoint. Refer to Figure 3D-45.

Press the **-D▶** button. The waypoint page for the selected waypoint will be displayed on the right side. Refer to Figure 3D-46.

Press the **ENT** button to approve the waypoint page. The DIRECT TO waypoint identifier in the active flight plan will now be preceded by an arrow. Refer to Figure 3D-47. The symbol is not displayed since there is no FROM waypoint.

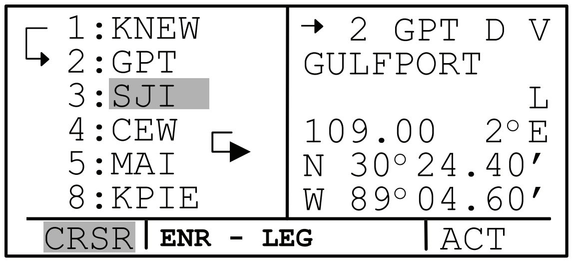


Figure 3D-45. Select the DIRECT TO Waypoint

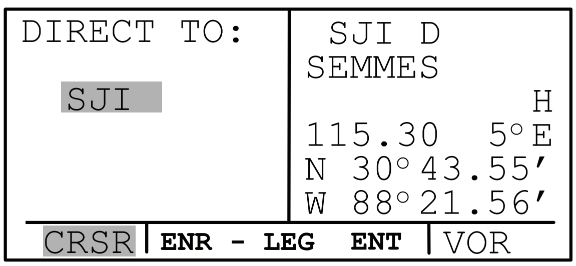


Figure 3D-46. The DIRECT TO Waypoint

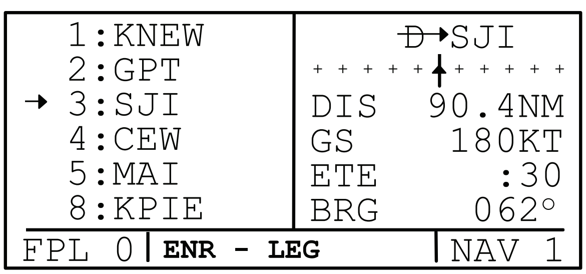


Figure 3D-47. DIRECT TO Navigation

(2) An alternate method is to use the Super NAV 5 page to select the Direct To waypoint.

Pull out on the right inner knob. With the inner knob out, it is possible to scan through the waypoints of the active flight plan. When the desired waypoint is highlighted, press the D→ button and then the **ENT** button.

To cancel DIRECT TO operation prior to reaching the DIRECT TO waypoint in order to proceed along the flight plan leg, press the D→ button, press the clear button, and then press the **ENT** button.

DISTANCE/TIME PAGES.

The distance/time pages are used with the active flight plan.

Distance/Time 1 Page. When the FPL 0 page is displayed on the left side and the D/T 1 page is displayed on the right side, the distance and estimated time en route are displayed for each of the active flight plan waypoints. The distance displayed is the cumulative distance from the aircraft's present position to each waypoint along the flight plan route. The ETE is displayed in hours and minutes. Refer to Figure 3D-48. If DIRECT TO operation is occurring to a waypoint that is not in the active flight plan, the D/T page is blank when the FPL 0 page is displayed on the left.

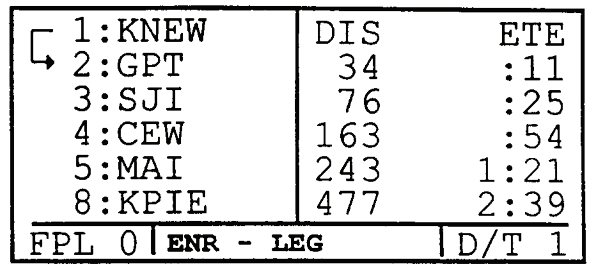


Figure 3D-48. Distance/Time 1 Page

If a numbered flight plan page is displayed on the left side, the distances displayed are from the first waypoint in the flight plan and have nothing to do with the aircraft's position. No ETE's are shown.

If a non-flight plan page is displayed on the left side, the format of the D/T1 page changes to display just the distance and ETE for the active waypoint and for the last waypoint in the flight plan. Refer to Figure 3D-49.

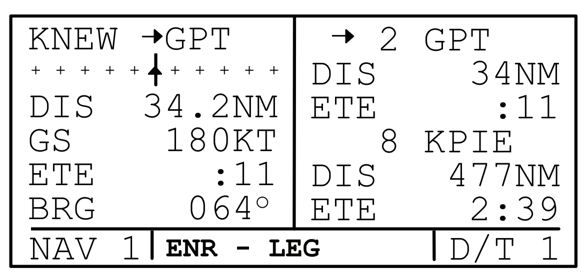


Figure 3D-49. Non-Flight Plan, Distance/ Time 1 Page

Distance/Time 2 Page. When FPL 0 is displayed on the left side and the D/T 2 page is displayed on the right side, the distance and estimated time of arrival are displayed for each of the active flight plan waypoints. Refer to Figure 3D-50. The distances are as described for the D/T 1 page. The time zone may be changed by enabling the right cursor function to bring the cursor over the time zone, and then turning the right inner knob to select the desired time zone. Changing the time zone on the D/T 2 page changes the time zone on other pages where time is displayed.

1:KNEW	DIS	UTC
2:GPT	34	15:23
3:SJI	76	15:37
4:CEW	163	16:06
5:MAI	243	16:33
8:KPIE	477	17:51
FPL 0	ENR - LEG	D/T 2

Figure 3D-50. Distance/Time 2 Page

If a numbered flight plan page other than FPL 0 is displayed on the left side, no estimated times of arrival are displayed.

If a non-flight plan page is displayed on the left side, the format of the D/T 2 page changes to display just the distance and the estimated time of arrival for the active waypoint and for the last waypoint in the flight plan.

Distance/Time 3 Page. When any flight plan page is displayed on the left side and the D/T 3 page is displayed on the right side, the distance and desired track are displayed. The distances are as described for the D/T 1 page. The desired track is the great circle course between two waypoints. Refer to Figure 3D-51.

1:KNEW	DIS	DTK
2:GPT	34	063°
3:SJI	76	061°
4:CEW	163	085°
5:MAI	243	092°
8:KPIE	477	172°
FPL 0	ENR - LEG	D/T 3

Figure 3D-51. Distance/Time 3 Page

If a non-flight plan page is displayed on the left side, the format of the D/T 3 page changes to display just the distance and desired track for the active waypoint and for the next waypoint in the flight plan. Note that this is different from the D/T 1 and D/T 2 pages

Distance/Time 4 Page. The format for the D/T 4 page does not change. Refer to Figure 3D-52. It displays on a single page the pertinent times for the flight regardless of what is displayed on the left side and regardless of whether flight plan or direct to operation is occurring. The following information is displayed on the D/T 4 page.

KPIE	UTC
DEP	15:02
TIME	15:12
ETA	17:51
FLT	:10
ETE	2:39
	D/T 4

Figure 3D-52. Distance/Time 4 Page

The destination waypoint.

The Selected Time Zone. The time zone may be changed by pressing the right **CRSR** button and using the right inner knob to select the desired time zone.

The Departure Time. There are two definitions of departure time depending on what has been selected on the SET 4 page. If the SET 4 page displays, RUN WHEN GS > 30 knots, the departure time is that time when the groundspeed first reached 30 knots. If the SET 4 page displays, RUN WHEN POWER IS ON, the departure time is the time when power was applied to the KLN 90B.

The present time.

The estimated time of arrival at the destination waypoint.

T*he Flight Time.* If RUN WHEN GS > 30 knots is selected on the SET 4 page, flight time is the amount of time that the aircraft's groundspeed has been above 30 knots. Normally, this will be the time since takeoff. However, time spent at groundspeeds less than 30 knots, such as intermediate stops without shutting down power, is not counted as flight time. If RUN WHEN POWER IS ON is selected on the SET 4 page, flight time is the time since power on.

Estimated time en route to the destination.

MODES OF OPERATION.

The course to the active waypoint is defined by selecting between two course modes, LEG and OBS. The LEG mode means the course to the active waypoint is selected by the KLN 90B. It is the default mode when power is applied to the KLN 90B. The OBS course mode is the mode that allows the pilot to define the course to the active waypoint.

The KLN 90B also has three modes that are associated with approach operation: En Route, Approach Arm, and Approach Active.

The status of the course modes and the approach modes are annunciated in the lower center segment of the screen. The exceptions to this are on the turn on page where the mode is not annunciated and on the Super NAV 5 page where the mode is annunciated on the left side of the screen. The abbreviations used for mode annunciation are detailed in Table 3D-14.

Table 3D-14. Course Modes

DISPLAY	EXPLANATION
APR – LEG	Approach Active – Leg
ARM – LEG	Approach Arm – LEG
ARM : 259	Approach Arm – OBS
ENR – LEG	En route – Leg
ENR: 274	En route – OBS

The approach active – OBS mode is not a valid mode and cannot be selected. For the OBS modes, the number included in the annunciation is the magnetic course selected by the pilot.

Selecting the Mode. The mode cannot be selected with the MOD pages because the external course mode selector/annunciator is used.

Locate the external course mode selector/annunciator.

Press the switch and it will change the modes and annunciate the mode selected.

Leg Mode. The characteristics of the leg mode are as follows.

The default Course Deviation Indicator (CDI) sensitivity is ± 5 nautical miles, full scale. This applies to the CDI on the NAV 1 page as well as the external EHSI. If the EHSI has five dots left and right of the center position, each dot represents one nautical mile of deviation.

NOTE

In some installations where the KLN 90B is interfaced to certain models of EFIS equipment, the scale factor will be plus or minus 7.5 nm, full scale.

Navigation is provided along the great circle path between two waypoints. Great circle navigation is the shortest distance between two points located on the earth's surface. In case of Direct To operation, the From waypoint is not displayed but it is the point where direct to operation was initiated. The course to fly while in this mode is referred to as the DTK. The desired track is displayed on the NAV 3 and D/T 3 pages. The Super NAV 5 page can also be configured to display the desired track. To fly a great circle course between two points, the desired course may be constantly changing.

Automatic waypoint sequencing is provided during flight plan operation. As a waypoint is reached, the next leg of the flight plan automatically becomes active.

Turn anticipation may be utilized in flight plan operation.

The minimum En route Safe Altitude (ESA) displayed on the NAV 3 page is the highest MSA sector altitude from the present position to the destination waypoint along the active flight plan or direct to route, whichever is in use.

OBS Mode.

The default CDI sensitivity is ± 5 nautical miles, full scale. This applies to the CDI on the NAV 1 page as well as the external EHSI. If the EHSI has five dots left and right of the center position, each dot represents one nautical mile of deviation.

NOTE

In some installations where the KLN 90B is interfaced to certain models of EFIS equipment, the scale factor will be ± 7.5 nautical miles, full scale.

The course is defined by the active waypoint and the selected magnetic course. A course to or from the waypoint may be selected.

The course selection is normally made by changing the selected course displayed on an external indicator such as an EHSI or EFIS. When this is done, the pilot must verify that the proper course has been selected by confirming the digital selected course readout displayed on the KLN 90B. In the OBS mode, the selected course is always displayed as part of the mode annunciation at the bottom center of the screen on all pages except the Super NAV 5 page. Refer to Figure 3D-53. On the Super NAV 5 page, the mode/annunciation is displayed on the left side of the screen. Two or more navigation sources can be selected as the primary navigation source displayed on the EHSI or EFIS. In the F3, the primary navaid selector switch on the pilot's side of the instrument panel is used to determine the navigation source displayed. For the KLN 90B to properly read the external indicator, the KLN 90B must be the displayed navigation source on the external indicator.

→GGT	→GGT
OBS: 234°	+ + + + + + + + + + +
TK 233°	DIS 20.0NM
FLY R 0.0NM	GS 154KT
MSA 4500FT	ETE :08
ESA 4500FT	BRG 234°
NAV 3 ENR : 234	NAV 1

Figure 3D-53. OBS Mode Indications

When the KLN 90B is not the displayed navigation source on the external indicator or if the KLN 90B is interfaced with an EFIS system, it is possible to change the selected course from several pages on the KLN 90B. This can be done from the NAV 3 page, the MOD 2 page, and the Super NAV 5 page if it is configured to display the track on the left-hand side.

NOTE

To tell if it is possible to enter the OBS value, note the OBS field. If a colon follows the letters OBS, it is possible to enter a value. If the colon is missing, the course must be changed from the external indicator.

If the KLN 90B is interfaced to EFIS or an electrically driven mechanical indicator, the external indicator will be slewed to agree with what was entered on the KLN 90B.

Select the NAV 3, MOD 2 or Super NAV 5 page.

Press the appropriate **CRSR** button to turn on the cursor function. If the course is being changed from the Super NAV 5 page, use the left outer knob to rotate the cursor over the OBS field.

Turn the appropriate inner knob to select the course.

Press the **CRSR** button to turn off the cursor function.

There is no automatic leg sequencing or turn anticipation.

The minimum ESA displayed on the NAV 3 page is the highest MSA sector altitude from the present position to the active waypoint. Other waypoints in the active flight plan do not affect the ESA.

When the active waypoint is a VOR or approach waypoint, the published magnetic variation for the VOR or approach waypoint is utilized rather than the calculated magnetic variation.

Switching From the LEG Mode to the OBS Mode. The following mode transition occurs if the KLN 90B is in the LEG mode and the mode is changed to OBS.

The waypoint that was active in LEG mode prior to the mode change remains the active waypoint in OBS mode.

The selected course is defined by two different methods depending on the installation and status of the unit.

If the KLN 90B is the displayed navigation source when the change is made to the OBS mode, the selected course becomes whatever was set on the external indicator prior to changing to the OBS mode. This value should normally be the desired track to the active waypoint that was already set on the external indicator if it was set pictorially correct.

If the KLN 90B is interfaced with a compatible EFIS, electrically driven mechanical EHSI, or is not displayed on the external indicator, the selected course is chosen by the KLN 90B such that the deviation from the selected course remains the same.

If the OBS value chosen by default is unacceptable, the pilot may choose the OBS value as described in paragraph 3D-20.c.

Switching From the OBS Mode to the LEG Mode. The following mode transition occurs if the KLN 90B is in the OBS mode and is switched to the LEG mode.

The active waypoint, while in the OBS mode, remains the active waypoint when the LEG mode is activated. The system does not attempt to orient itself on a leg of the active flight plan unless the TO / FROM indicator is indicating FROM. In this case, the KLN 90B will reorient on the active flight plan.

The active selected course in the OBS mode prior to switch to a LEG mode becomes the desired track in the LEG mode, unless the switch was made on the FROM side, in which case the KLN 90B will calculate the correct desired track for the new leg.

With the exception of (2) above, the characteristics of normal DIRECT TO operation apply.

Going DIRECT TO a Waypoint While in the OBS Mode. The DIRECT TO function will select the OBS value that will take the aircraft from the present position directly to the active waypoint when the KLN 90B is interfaced to a compatible EFIS, an electrically driven mechanical EHSI, or when the KLN 90B is not the displayed navigation source on the external indicator.

If the KLN 90B is the displayed navigation source on a non-driven EHSI, it is not possible for the KLN 90B to change the OBS value. In these situations, the KLN 90B will provide a Status line message that will announce the OBS value that should be selected to go direct to the active waypoint. Refer to Figure 3D-54.

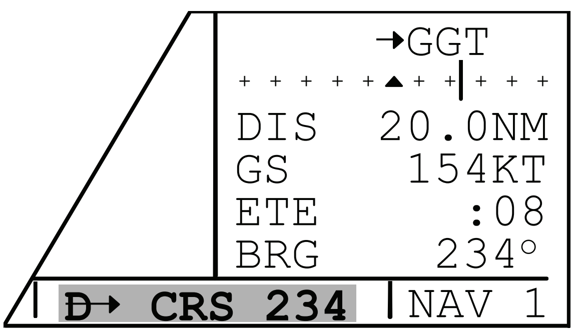


Figure 3D-54. OBS DIRECT TO Course

Activating a Waypoint While In the OBS Mode. While in the OBS mode, a waypoint may be activated by using the normal DIRECT TO method or by a second method. This second method activates another waypoint without changing the selected course. When the new waypoint is activated, the deviation bar is not centered.

Press the —D→ button. The rules for the priority of waypoint selected for direct to operation apply.

Press the —D→ button a second time. The annunciation DIRECT TO changes to ACTIVATE. The right side still displays the appropriate waypoint page.

Repeated presses of the **D** button alternates between DIRECT TO and ACTIVATE. Ensure ACTIVATE is displayed. Refer to Figure 3D-55.

Press the **ENT** button to approve the waypoint page and activate the waypoint. The selected course does not change, therefore this method does not re-center the deviation bar like a DIRECT TO operation.

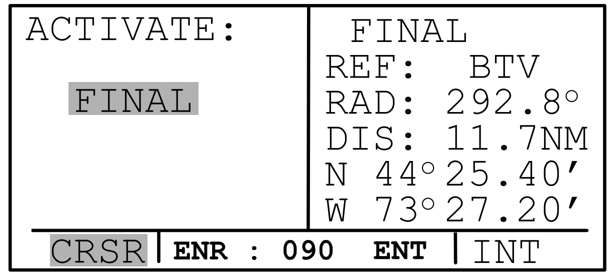


Figure 3D-55. Activating a Waypoint

Changing the CDI Scale Factor. The CDI scale factor can be changed by using either the MOD 1 or MOD 2 pages. In normal operation, it is possible to select a CDI scale factor that is ± 5 nm, 1 nm, or 0.3 nm full-scale defection.

NOTE

The KLN 90B will automatically select a scale factor while in one of the approach modes. When the KLN 90B selects a CDI scale factor, it is not possible to select a scale factor that is less sensitive.

Select either the MOD 1 or MOD 2 page.

Press the left **CRSR** button. If necessary, use the left outer knob to move the cursor over the value of the CDI scale.

Rotate the left inner knob to select the desired scale factor.

Turn the left cursor function off.

APPROACH OPERATIONS.

Non-Precision Approach Operations. In the F3, the message/waypoint (MSG/WPT) annunciator, the GPS course selector /annunciator (GPS CRS), and the approach mode selector/annunciator (GPS APR), must be operational.

CAUTION

The KLN 90B obtains approach information from the database and the database must be current. The KLN 90B is approved for IFR non-precision approaches only when the database is current. If an approach is selected when the database is out of date, a status line message, OUTDATED DATABASE will display in the bottom center of the screen.

The Super NAV 5 page has been specifically designed to provide most of the functions needed for non-precision approaches. This page provides an interface that presents pertinent navigation information, a way to access the flight plan, and a graphic presentation of the present position relative to the flight plan waypoints.

NOTE

Some approach procedures are not suited for the operational characteristics of the KLN 90B. These procedures are not included in the database. Ensure that the KLN 90B contains anticipated procedures for the flight.

In addition to the LEG and OBS course modes, there are also two approach modes. These are approach arm and approach active. The status of the approach mode is indicated both on the external switch/annunciator and on the status line of the KLN-90B. The external annunciator will indicate ARM for the approach arm mode and approach active will be annunciated by ACTV. The main difference between these modes from the normal en route mode is that the integrity monitoring is set to a tighter level. Another difference between these modes and the en route modes is the CDI scale factor will usually change to ± 1.0 nm for ARM and will always change to ± 0.3 nm when in the APR ACTV mode.

The ARM mode can be selected in two ways. The normal way is that this mode will be selected automatically by the KLN 90B when the aircraft is within 30 nm of the destination airport and an approach for that airport has been loaded in the flight plan. It is possible to arm the approach mode at a distance greater than 30 nm from the airport by pressing the **GPS APR** switch, but the KLN 90B will not change the CDI scale factor until the aircraft reaches the 30-nm point. If the **GPS APR** external switch is pressed while the approach mode is armed, the KLN 90B will disarm the approach and change back to en route mode. The CDI scale factor will also change back to ± 5.0 nm. The approach can be rearmed by simply pressing the **GPS APR** switch again.

The APR ACTV mode can only be engaged automatically by the KLN 90B. To cancel the APR ACTV mode, press the external **GPS APR** switch. This will change the mode to APR ARM. Once past the FAF, it is not possible to return to the approach active mode without conducting a missed approach and flying back to the FAF.

General Procedures for Non-Precision Approaches. Non-precision approaches will all have the same general flow. Refer to Figure 3D-56.

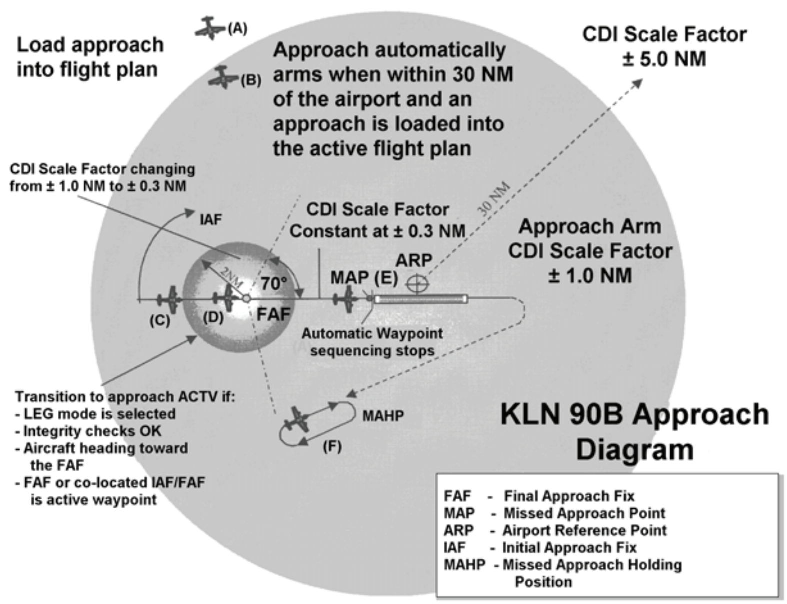


Figure 3D-56. Approach Sequence

(3) Select and Load the Approach Into the Flight Plan. This can be done at almost anytime, but must be completed before reaching the final approach fix and should be done as soon as possible (position A). If the aircraft is greater than 30 nm from the airport, the CDI scale factor will remain at the default ± 5.0 nm full scale deflection.

Transition to the Approach Arm Mode. This will occur automatically when the aircraft is within 30 nm of the airport and there is an approach loaded into the flight plan (position B). The CDI scale factor will change to ± 1.0 nm over the next 30 seconds and the external annunciator will indicate ARM.

Get Established on the Final Approach Course.

No PT arrival route.

Radar vectors (requires OBS mode).

Procedure turn or holding pattern (requires OBS mode).

DME arc.

Transition to the Approach Active Mode. This mode change is automatic and occurs at position C when:

The aircraft is 2 nm from the FAF and the approach mode is armed.

The LEG mode is selected.

The aircraft is heading towards the FAF.

The FAF or a co-located IAF/FAF is the active waypoint.

The KLN 90B confirms that adequate integrity monitoring is available to complete the approach.

If any of these conditions are not met, the KLN 90B will not transition to the approach active mode and a missed approach will be required if the conditions do not change before reaching the FAF. If all of these conditions are met, the CDI scale factor will start to change to ± 0.3 nm and the external annunciator will indicate ACTV.

At the FAF (position D), the CDI scale factor will be at ± 0.3 nm and will remain at this scale factor until the approach mode is canceled by pressing the external **GPS APR** button to change to the ARM mode, by initiating a direct to operation, or by changing to the OBS mode.

WARNING

It is not approved to conduct the final portion of the approach unless the KLN 90B is in the approach active mode.

Fly to the missed approach point (position E). The KLN 90B will not automatically sequence to the next waypoint, it must be manually selected. By default, the KLN 90B will nominate the first waypoint of the published missed approach procedure when the -D▶ button is pressed and the active waypoint is the MAP.

If necessary, conduct the missed approach procedure. Always refer to the approach chart when conducting a missed approach. The KLN 90B does not include headings and altitude restrictions common to missed approach procedures. The OBS mode is usually needed at some point during a missed approach and is always required to fly a holding pattern (position F).

Selecting an Approach. Approaches are selected from the APT 8 or ACT 8 page for the destination airport.

NOTE

Approaches can only be entered in FPL 0, the active flight plan. If the KLN 90B is turned off for more than 5 minutes, the approach is deleted when power is turned back on.

7. Turn to the APT or ACT pages and select the destination airport using the right cursor inner and outer knobs.

Use the right inner knob to turn to the APT or ACT 8 page. The APT 8 page can be reached by turning the right inner knob one step counterclockwise from the APT 1 page.

Turn the right cursor on. The right cursor comes up on the first approach in the list of approaches. Use the right outer knob to move the cursor to the different approaches. Refer to Figure 3D-57. If there are more than five approaches to an airport, move the cursor down to scroll the other procedures into view by rotating the right inner knob clockwise.

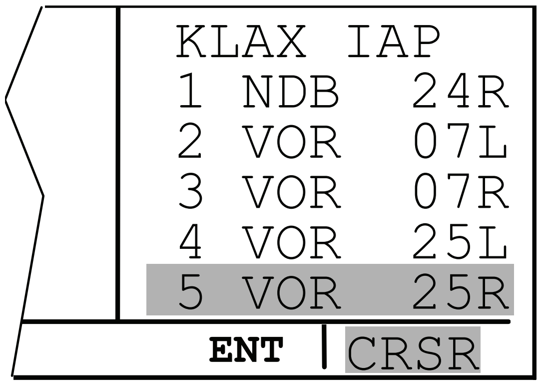


Figure 3D-57. Selecting the Approach

With the cursor over the desired approach, press the **ENT** button.

The KLN 90B will present a list of Initial Approach Fixes (IAF) corresponding to this approach. Select the appropriate IAF by placing the cursor over the IAF and pressing the **ENT** button. Refer to Figure 3D-58.

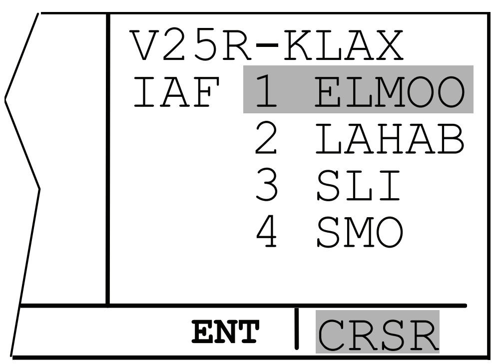


Figure 3D-58. Selecting the Initial Approach Fix.

The KLN 90B next presents a list of waypoints that make up the approach. Refer to Figure 3D-59. Review the waypoints to ensure the correct IAF has been selected. If there are more than four waypoints in the approach, move the cursor up with the right outer knob to scroll the other waypoints into view.

NOTE

If there is only one IAF for a procedure, the KLN 90B will skip this screen.

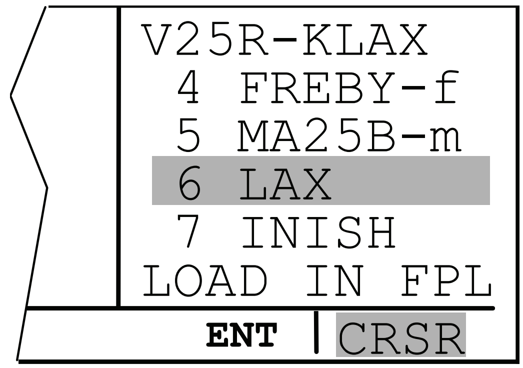


Figure 3D-59. Approach Waypoints

If the cursor is over LOAD IN FPL and the **ENT** button is pressed, the KLN 90B checks to see if this airport is in the active flight plan. Refer to Figure 3D-60. If it is not, the KLN 90B will ask if the approach and airport are to be added to the active flight plan.

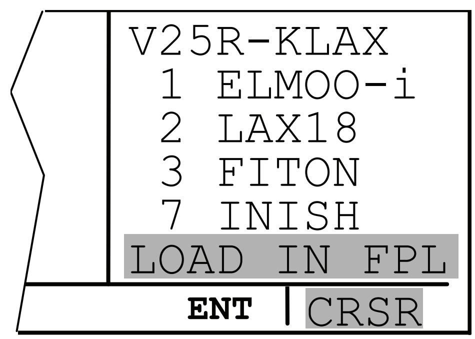


Figure 3D-60. Loading the Approach

The KLN 90B will then bring up the FPL 0 page and put the sequence of approach waypoints in front of the airport reference point.

NOTE

At any time during the process of selecting an approach, return to the previous step by pressing the CLR button.

At the top of the list of approach waypoints is a header that describes the approach that follows. The form of this header is ABBBB-CCCC. A is the first letter of the type of approach (e.g., V for VOR). BBBB will be filled in with the runway that the approach is to. Finally, CCCC corresponds to the identifier of the airport that the approach is to. For example, V25R-KLAX means the VOR 25R approach to KLAX.

After the approach has been entered into the flight plan, the KLN 90B checks to make sure that the resulting flight plan makes sense. If the KLN 90B detects any waypoints that are in both the en route portion of the flight plan and the portion that makes up the approach, the following message will be given, REDUNDANT WPTS IN FPL – EDIT EN ROUTE WPTS AS NECESSARY.

Check the flight plan and delete those en route waypoints that are not necessary.

Naming Conventions of Terminal Waypoints. Note waypoint five in the VOR 25R to KLAX. Refer to Figure 3D-59. This is the missed approach point for runway 25. This approach applies to both left and right runways so the letter B is used to mean both. Refer to Table 3D-15 for naming conventions.

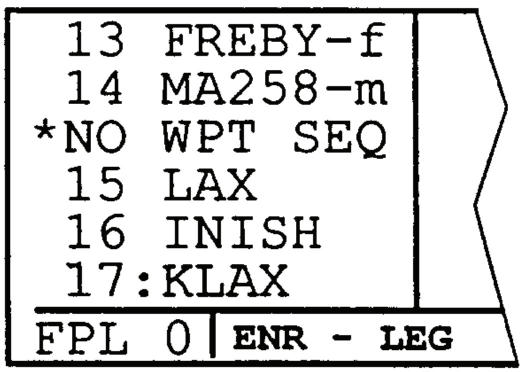


Figure 3D-61. No WPT Sequencing.

In Table 3D-15, x and yyy are defined as follows: for runways with only one approach, x will be replaced with an A or an F; and for runways that have multiple approaches, x will be replaced with V for VOR, N for NDB, or R for RNAV. The letters yyy will be replaced with either the runway identifier (e.g. FF25L) or, for circling approaches, the inbound course to the missed approach point (e.g. MA259).

Waypoints along a given radial will be named such that the first three letters are the reference VOR/DME and the next two are the DME distance. If the distance is greater than 100 nm, the order is reversed. For example, LAX18 is 18 nm from LAX while 26FLW is 126 nm from FLW.

Table 3D-15. Approach Waypoint Naming Conventions

DISPLAY	EXPLANATION
Cxyyy	C stands for course fix
Daaab	D stands for DME arc waypoint. Aaa is the radial that the fix is on from the reference VOR. B will be a letter corresponding to the distance from the reference VOR. For example, G is the seventh letter of the alphabet so D234G would be a point on the 234° radial 7 nm from the reference VOR. DME arcs greater than 26 nm will have waypoints where the first two characters are the first two letters of the DME identifier. The next three characters will be the radial that the arc waypoint is on.
Fxyyy	F stands for final approach fix
Ixyyy	I stands for intermediate approach fix
Mxyyy	M stands for missed approach fix
RWzzz	RW stands for runway fix. This is usually the MAP for the approach. Zzz will be a runway number, possibly including L for left, R for right, C for center, or B for both.

Some waypoints have a dash and a small letter at the end of the waypoint name. The small letter is an aid to help recognize important points in an approach. These suffixes are displayed on the FPL 0 page, the Super NAV 5 page, and the Super NAV 1 page. The suffixes are shown in Table 3D-16.

Table 3D-16. Approach Waypoint Suffixes

SUFFIX	EXPLANATION
f	final approach fix
i	initial approach fix
m	missed approach point
n	missed approach holding point

Every approach will have an FAF and a MAP. Almost all will have an IAF and a missed approach holding point.

Another item in the flight plan is the line *NO WPT SEQ. This is what is referred to as a fence and is an alert that the KLN 90B will not automatically sequence past the waypoint that precedes the fence. The waypoint before the fence is always the missed approach point. The reason that waypoint sequencing is not allowed is that many missed approach procedures require specific action before going to the missed approach holding point e.g., climbing on a fixed heading until reaching an altitude.

Changing or Deleting an Approach Once Loaded Into the Flight Plan. The sequence of waypoints retrieved from the database of the KLN 90B define the approach procedures as they are charted.

To ensure that the proper path over the ground is followed, it is not possible to either delete or add waypoints to the approach section of the flight plan. To help see which waypoints are en route waypoints and which are approach waypoints, the KLN 90B does not display a colon next to the waypoint number on the FPL 0 page if the waypoint is an approach waypoint.

It is only possible to replace the existing approach with another one or delete the entire approach from the flight plan.

With the left page displaying the active flight plan (FPL 0), turn the left cursor on. Refer to Figure 3D-62.

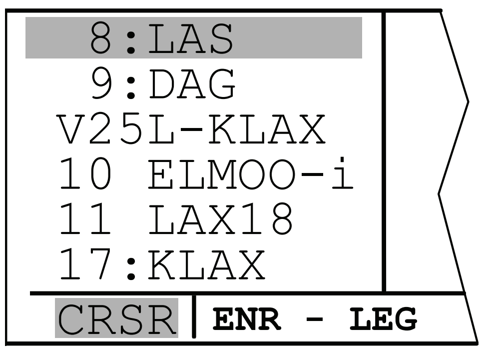


Figure 3D-62. FPL 0 with Approach

Move the cursor so that it covers the approach header at the top of the approach procedure. Refer to Figure 3D-63. Once the cursor comes over the approach header, it will change to read CHANGE APR?. If the **ENT** button is pressed, the APT 8 page will automatically come up on the right side. Now it is possible to select different approach procedures, different IAF's, or both.

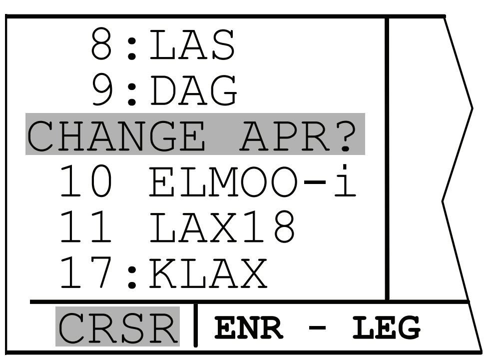


Figure 3D-63. Change the Approach

If the clear button is pressed while the cursor is over the approach header, it will change to read DELETE APR?. Refer to Figure 3D-64. If **ENT** is pressed now, the KLN 90B will remove the entire approach procedure from the active flight plan. If the KLN 90B was in the approach arm or the approach active modes, deleting the approach will cause the KLN 90B to change back to the en route mode. This means the CDI scale factor will change back to the default ± 5.0-nm scale.

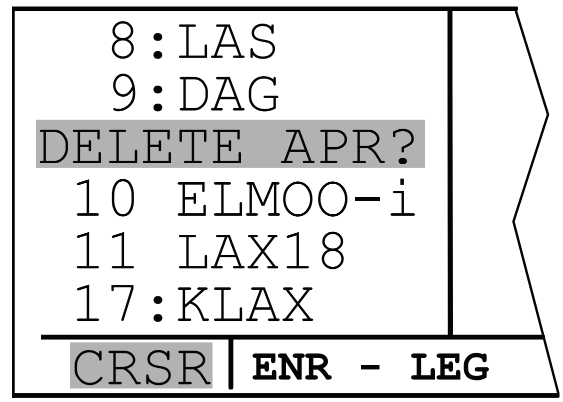


Figure 3D-64. Delete the Approach

No Procedure Turn Approach. This example will show how the KLN 90B sequences through an approach that does not require a procedure turn. It will remain in the LEG mode throughout the approach.

Load the approach into the flight plan. At 30 nm the KLN 90B will automatically arm the approach mode and in the F3 provide the message, PRESS ALT TO SET BARO. Press the ALT button to bring up the ALT page and verify that the altimeter setting is correct. At this time, the KLN 90B will change the CDI scale factor to ± 1.0 nm. The external approach mode annunciator will indicate that the approach is in the ARM mode.

As the initial approach fix is approached, the KLN 90B will provide waypoint alerting on the external waypoint annunciator, as well as on the screen of the KLN 90B. Once the IAF is passed, the KLN 90B will sequence to the next waypoint on the approach.

Use of the Super NAV 5 page is recommended because of its graphic presentation of the aircraft location and the approach course. Refer to Figure 3D-65.

As the aircraft approaches the next waypoint, the KLN 90B will again provide waypoint alerting. Each time the aircraft passes a waypoint and sequences to the next waypoint, the KLN 90B will provide a message annunciating the new value to set on the EHSI. If DTK is shown on the screen, this value will flash when the external selected course does not match the DTK within 10°.

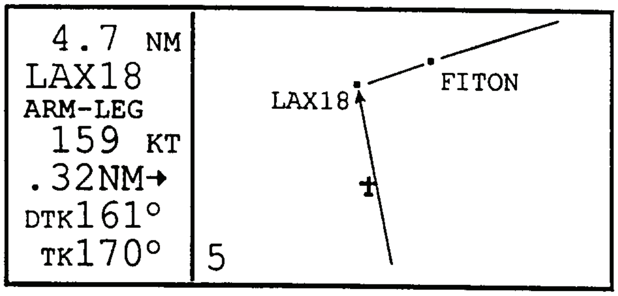


Figure 3D-65. Super NAV 5 Page

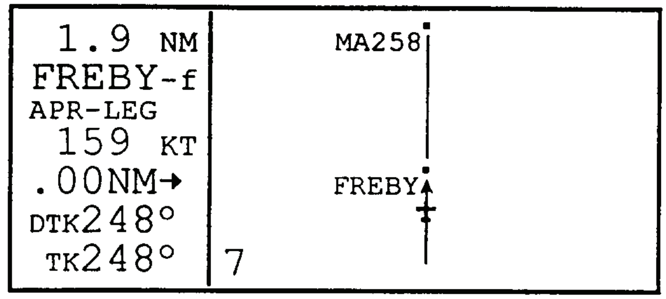


Figure 3D-66. GPS Approach Mode Active

NOTE

If the KLN 90B is interfaced with EFIS or an electrically driven mechanical indicator (HSI), the external indicator will be driven to the correct value when leg sequencing occurs.

As the aircraft approaches the final approach fix, verify that the LEG mode is selected and that GPS is selected as the primary navigation source.

Two nautical miles from the final approach fix, the KLN 90B will make a prediction to see if integrity will be available at the FAF and MAP. If the prediction indicates that integrity monitoring will be available, and RAIM is currently available, the KLN 90B will change the GPS APR annunciator to read ACTV and the status line will indicate APR. Refer to Figure 3D-66. At this time, the KLN 90B will also start to change the CDI scale factor. By the time the aircraft reaches the FAF, the CDI scale factor will at ± 0.3 nm full-scale deflection.

NOTE

Some approach procedures require adding up several along track distances to be able to identify a step down fix.

A step down fix may not be included. Identify this point by using the along track distances given in the profile view of the approach plate. Remember, in the leg mode, the distance given by the KLN 90B is the distance to the next point (in this case, the MAP), not the distance from the last point (the FAF).

The KLN 90B will again provide waypoint alerting as the missed approach point is approached. In the C-12F3 this is shown on the Super NAV 5 page as a flashing active waypoint identifier, as well as the external flashing waypoint annunciator. If the auto scale factor was chosen for the Super NAV 5 page, the airport diagram will be visible when the aircraft is within 5 nm of the airport. More detail is shown as the aircraft gets to within 1 nm of the airport.

NOTE

If ATC instructions for the missed approach are different from the published procedure, it is always possible to select a different DIRECT TO waypoint from the default DIRECT TO waypoint.

If a missed approach is required, the KLN 90B will not automatically sequence past the missed approach point. To perform the published missed approach procedure, press the -D→ button to bring up the Direct To page. The default waypoint will be the first waypoint of the published missed approach procedure. Confirm this waypoint as the DIRECT TO waypoint and press the **ENT** button.

Upon reaching the first point, the KLN 90B will sequence to the next waypoint in the missed approach procedure.

Off Airport Navaid Approach.

8. Load the approach into the flight plan. If there is only one IAF, the KLN 90B does not give the option to choose an IAF. If there is no active flight plan (i.e., direct to navigation is being used without an active flight plan), the KLN 90B will ask to add the airport and the approach to FPL 0. Refer to Figure 3D-67.

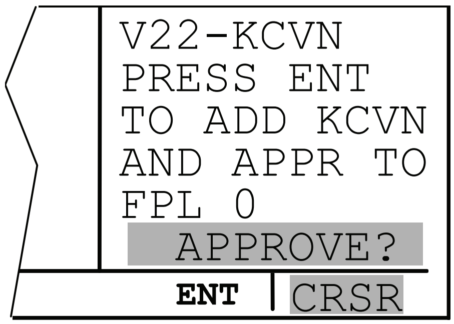


Figure 3D-67. Loading the Approach

If ATC then clears the aircraft to the IAF, with the Super NAV 5 page displayed, pull out the right inner knob and scan through the active flight plan. Once the IAF is displayed in the scanning window, press the D→ button and then the **ENT** button to initiate a direct to operation to the IAP.

At a distance of 4 nm to the IAF, the KLN 90B will give the message, IF REQUIRED SELECT OBS.

This message provides a reminder that to fly a course reversal, the OBS mode needs to be selected. If the aircraft is approaching the IAF from an area where there is no need to perform a course reversal, ignore the message. A NoPT arrival sector is not stored in the database, so it is not possible for the KLN 90B to know that the course reversal is not required. Therefore, the KLN 90B will always give the message whenever a waypoint could be used for a course reversal. If the aircraft is approaching from a NoPT arrival sector, remain in the LEG mode. The KLN 90B will properly sequence to the FAF to MAP leg and transition to the approach mode when 2 nm from the IAF/FAF.

If approaching from a direction that requires a course reversal, the OBS mode will need to be selected. If the OBS mode is not selected before reaching the IAF/FAF, the KLN 90B will automatically sequence to the missed approach point. This is not desirable if a course reversal is to be done.

NOTE

The KLN 90B will only provide the reminder to select OBS if the IAF is the active waypoint.

If a course reversal is required, perform the appropriate procedure and set the inbound course on the EHSI upon reaching the IAF. At this point, the KLN 90B works very similar to a conventional VOR/DME.

Once established on the inbound course, switch back to the LEG mode. When LEG mode is selected, the FAF is automatically made the active waypoint when the IAF and the FAF are the same waypoint.

NOTE

It is mandatory that the unit be in the LEG mode with the FAF as the active waypoint before crossing the FAF to activate the approach active mode and change to ± 0.3 nm scale factor. The CDI scale factor changes from ± 1.0 nm to ± 0.3 nm over the 2 miles to the FAF. Delaying the switch from OBS to LEG mode compresses the scale factor change. This will make the transition more abrupt. If the switch from OBS to LEG is delayed too long, it will not be possible for the KLN 90B to change to the approach active mode.

When the aircraft is 2 nm from the FAF, the KLN 90B will verify that proper integrity is available. If integrity monitoring is available for the approach, the KLN 90B will change to the approach active mode. This will be annunciated on the external approach status annunciator as well as on the KLN 90B. The CDI scale factor will also start to change from ± 1.0 nm to ± 0.3 nm.

Upon reaching the FAF, the KLN 90B will automatically sequence to the MAP.

A step down fix may not be included. Identify this point by using the along track distances given in the profile view of the approach plate. In the leg mode, the distance given by the KLN 90B is the distance to the next point (in this case, the MAP), not the distance from the last point (the FAF).

The KLN 90B will provide waypoint alerting as the missed approach point is approached. In the C-12F3 this is shown on the Super NAV 5 page as a flashing active waypoint identifier, as well as the external flashing waypoint annunciator. If the auto scale factor was chosen for the Super NAV 5 page, the airport diagram will be visible when the aircraft is within 5 nm of the airport. More detail is shown as the aircraft gets to within 1 nm of the airport.

If a missed approach is required, the KLN 90B will not automatically sequence past the missed approach point. To perform the published missed approach procedure, press the D→ button to bring up the Direct To page. The default waypoint will be the first waypoint of the published missed approach procedure. Confirm this waypoint as the DIRECT TO waypoint and press the **ENT** button.

NOTE

If ATC instructions for the missed approach are different from the published procedure, it is always possible to select a different direct to waypoint than the default DIRECT TO waypoint.

Prior to reaching the first point, if holding is required, select the OBS mode to stop waypoint sequencing and define the inbound course for the holding pattern by setting the proper course on the EHSI. If the OBS mode is not selected before the aircraft is within 4 nm of the holding point, the KLN 90B presents a message as a reminder to select the OBS mode.

NOTE

If another attempt at the approach is desired after holding, it is necessary to manually change the active waypoint. When the FAF and the missed approach holding point are the same, the KLN 90B will change the active waypoint to the FAF when the change from OBS to LEG is made. Make sure to make this change as soon as possible to ensure the approach active mode becomes the active mode.

Radar Vectors.

9. Select the approach and enter it into the flight plan.

When ATC initiates radar vectors, change the active waypoint to the FAF and select OBS. The order of these steps is not important. It is just as effective to change to OBS mode and then change the active waypoint.

Change the selected course on the EHSI to the final approach course. It is possible to maintain the aircraft orientation on the Super NAV 5 page. Refer to Figure 3D-68.

Once established on the inbound course, change back to the LEG mode to allow for proper approach operation and automatic leg sequencing. For best performance, the change back to LEG mode should be made before the aircraft is 2 nm from the FAF.

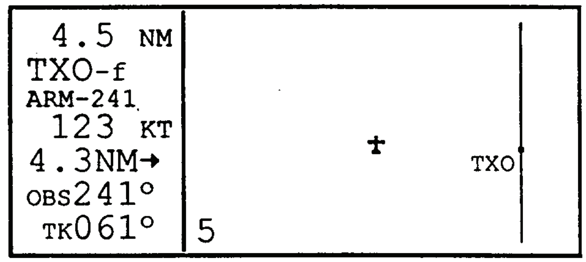


Figure 3D-68. Radar Vectors

NOTE

It is mandatory that the unit is in the LEG mode with the FAF as the active waypoint before crossing the FAF to activate the approach active mode and change to ± 0.3 nm scale factor. The CDI scale factor changes from ± 1.0 nm to ± 0.3 nm over the 2 miles to the FAF. Delaying the switch from OBS to LEG mode compresses the scale factor change. This will make the transition more abrupt. If the switch from OBS to LEG is delayed too long, it will not be possible for the KLN 90B to change to the approach active mode.

The rest of the approach will be flown using the same steps presented previously.

On Airport Navaid Approach.

10. Select the approach and enter it into the flight plan.

When the distance from the present position to the destination airport reaches 30 nm, the KLN 90B will arm the approach mode. The CDI scale factor will transition to ± 1.0 nm and the KLN 90B will provide more sensitive integrity monitoring. In the C-12F3, press the altitude button to update the altimeter setting.

When the aircraft is 4 nm from the IAF, the KLN 90B will provide a reminder to select the OBS mode. The OBS mode is required for the procedure turn. After passing the IAF, select the outbound course on the EHSI.

The aircraft is now headed outbound for the procedure turn. As soon as practical, change the active waypoint to the FAF.

a. Pull out the right inner knob with the Super NAV 5 page displayed. Scan the waypoints until the FAF, FFxx-f, is displayed in the window and press the -D▶ button. Refer to Figure 3D-69.

Since the course to the FAF is already defined (in the OBS mode with the EHSI set to the outbound course), press the **D** button a second time to activate this waypoint instead of going directly to it.

With the OBS mode selected and the FAF as the active waypoint, it is possible to fly the procedure turn. Allow enough distance past the FAF to complete the procedure turn and still be 2 nm away from reaching the FAF. After completing the heading portion of the procedure turn, change the selected course to the inbound course on the EHSI.

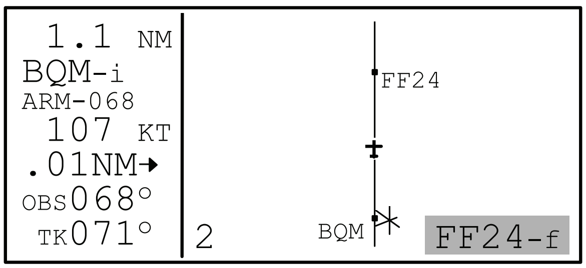


Figure 3D-69. Activate the FAF

Once established on the inbound course, the LEG mode will again need to be selected so that proper approach operation and waypoint sequencing will occur.

NOTE

It is mandatory that the unit is in the LEG mode with the FAF as the active waypoint before crossing the FAF to activate the approach active mode and change to ± 0.3 nm scale factor. The CDI scale factor changes from ± 1.0 nm to ± 0.3 nm within 2 miles to the FAF. Delaying the switch from OBS to LEG mode compresses the scale factor change. This will make the transition more abrupt. If the switch from OBS to LEG is delayed too long, it will not be possible for the KLN 90B to change to the approach active mode.

When the aircraft is 2 nm from the FAF, the KLN 90B will verify the proper GPS integrity is available. If integrity monitoring is available for the approach, the KLN 90B will change to the approach active mode. This will be annunciated on the external approach status annunciator as well as on the KLN 90B. The CDI scale factor will also start to change from ± 1.0 nm to ± 0.3 nm.

Normal waypoint alerting will occur as the aircraft passes the final approach fix. The leg from the final approach fix to the missed approach point will become active and the CDI scale factor will remain at ± 0.3 nm. If the auto scale factor was selected on the Super NAV 5 page, the scale factor will zoom in on the airport as the aircraft gets closer and closer to the missed approach point. Eventually the map scale changes to 1 nm and the runway diagram becomes visible on the map.

The missed approach instructions may call for a climbing turn to a heading to intercept a course to the missed approach holding point. To fly this with the KLN 90B, it will be necessary to put the KLN 90B into the OBS mode. Make the missed approach holding point the active waypoint. Change the selected course on the external EHSI to the published course to the missed approach holding point. Fly the heading until intercepting the course, then turn and track the course.

NOTE

The KLN 90B must be in the OBS mode for holding.

Once the aircraft reaches the missed approach holding point, perform the appropriate holding pattern entry. Set the selected course on the EHSI to the inbound holding course.

DME Arc Approach. DME arc procedures with the KLN 90B are different from traditional VOR and DME equipment. The KLN 90B provides left/right guidance around the arc.

ATC assigns the approach. Turn to the APT 8 page for the destination to select the approach. When the approach is selected, the KLN 90B presents the IAF selection page.

Two of the IAF's may be in the form DxxxY. These two waypoints are the database identifiers for the ends of the arc. D040L means DME arc point 040 is the radial on which the waypoint lies, and L indicates the distance of the arc. L is the twelfth letter of the alphabet so L indicates that this is the 12 NM DME arc.

CAUTION

The KLN 90B does not take into account the geometry of the active flight plan when determining the arc intercept point. This point is defined solely on the present radial and the defined arc distance from the reference VOR. For this reason, it is better to delay selecting approaches that contain DME arcs until the aircraft is closer to the destination.

NOTE

If the present radial from the reference VOR is outside of the defined arc, the KLN 90B will default to the beginning of the arc.

The KLN 90B recognizes if this point is associated with a DME arc. Once the arc waypoint is chosen, the KLN 90B determines on what radial of the reference VOR is presently located. A waypoint is created that is located at the intersection of the present radial and the DME arc. This waypoint is the first waypoint in the list of waypoints presented on the APT 8 page before loading the approach into the flight plan. This waypoint is named in the same convention as above.

With the cursor over LOAD IN FPL, press the **ENT** button. The approach will be loaded into the active flight plan.

After the approach is loaded into the flight plan, the KLN 90B may give the message, REDUNDANT WPTS IN FPL – EDIT EN ROUTE WPTS AS NECESSARY.

Examine the flight plan and, if practical, observe the Super NAV 5 page to make sure that the sequence of waypoints does not have any unnecessary legs in it.

The KLN 90B will now provide guidance to the arc intercept point. The Super NAV 5 page displays the entire arc on the screen. Refer to Figure 3D-70. The portion between the beginning of the arc and the arc intercept is drawn with a dashed line. The part that is between the arc intercept point and the end of the arc is drawn with the normal solid line.

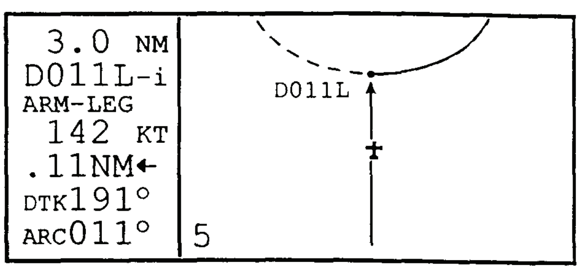


Figure 3D-70. DME ARC

In some cases, ATC may provide radar vectors to the arc. The KLN 90B provides a means to define a new intercept point based on the current track of the aircraft over the ground. This can be done from either the Super NAV 5 page or from the FPL 0 page. The dashed line on the Super NAV 5 page will help in determining if the ATC vectors are correct.

From the Super NAV 5 page, pull out the right inner knob to bring up the waypoint scanning window.

Turn the right inner knob until the first waypoint of the arc is displayed. For approaches, this will have an i appended to the waypoint name. If the recalculation is to be done from the FPL 0 page, turn on the left cursor and move it over the first waypoint of the arc.

From either page press the clear button. This will change the waypoint to read MOVE?. Refer to Figure 3D-71. If it is desired to re-compute the arc intercept point, press the **ENT** button. If a new arc intercept point is not desired, press the clear button again.

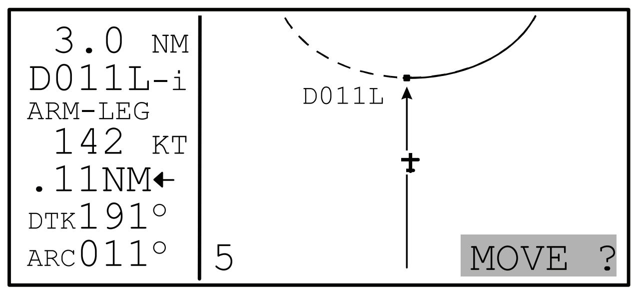


Figure 3D-71. DME ARC MOVE?

If the **ENT** button was pressed, the KLN 90B will calculate an arc intercept point based on the present track of the aircraft over the ground.

NOTE

If the present track does not intercept the arc, the KLN 90B will display NO INTRCPT on the screen.

When the aircraft approaches the arc, the KLN 90B will provide waypoint alerting and turn anticipation to join the arc.

Once established on the arc, the KLN 90B provides left/right guidance relative to the curved arc. Distance to the active waypoint is the distance from the present position to the active waypoint, not the distance along the arc.

During the arc, the desired track will be constantly changing. To help to keep the orientation correct, the Super NAV 5 page will automatically display DTK on the sixth line. It is not possible to change this while on the arc. The value displayed for the desired track will flash when the difference between the CDI or EHSI and the current desired track is greater than 10°.

Some DME arcs have defined radials that serve as step down fixes. These points are not stored in the database. To help determine the position relative to these step down points along the arc, the KLN 90B will display a new value on the bottom line of the display on the Super NAV 5 page. This value is denoted by the letters ARC followed by three numbers. The three numbers represent the current radial the aircraft is on relative to the reference VOR/DME. It is not possible to select any other information to display on this line. The arc radial is forced into this position when the aircraft is 30 nm from the arc.

NOTE

Autopilot performance may not be satisfactory if coupled in the NAV mode while flying the arc. Many autopilot systems were never designed to fly curved paths. If autopilot performance is unsatisfactory while flying DME arcs, select the heading mode and keep changing the heading bug to keep the deviation bar centered.

As the aircraft approaches the end of the arc, the KLN 90B will provide waypoint alerting and turn anticipation to the next leg.

When the aircraft is 2 nm from the FAF, the KLN 90B will attempt to transition to the approach active mode. Since the DME arc procedure is flown entirely in the LEG mode, the only possible problem would be if the integrity monitoring was not available.

If a missed approach is needed, perform the following.

If the missed approach calls for a climb and then a turn, the KLN 90B will provide correct guidance for the climb.

Once the correct altitude has been reached, press the **D** button. The first point in the published missed approach will be the default DIRECT TO waypoint. Press the **ENT** button to confirm the DIRECT TO waypoint.

NOTE

If ATC instructions for the missed approach are different from the published missed approach procedure, it is always possible to select a different DIRECT TO waypoint.

NOTE

If another attempt at the approach is desired after holding, it is necessary to manually change the active waypoint. When the FAF and the missed approach holding point are the same, the KLN 90B will automatically change the active waypoint to the FAF when the change from OBS to LEG is made. This change needs to be made as soon as possible to ensure the approach active mode becomes the active mode.

The OBS mode will need to be selected to either fly a specific course or radial to the waypoint or to hold at the missed approach holding point. If this is not done before the aircraft gets to 4 nm from the missed approach holding point, the KLN 90B will provide a reminder message to select OBS.

Approach Problems*.* Very rarely, there will be a problem with the integrity of the GPS system while conducting non-precision approaches. In some cases, the KLN 90B will determine that there will not be sufficient integrity monitoring for the leg between the FAF and the MAP, or RAIM is not currently available. In these cases, the KLN 90B will not go into the approach active mode and will present the message, RAIM NOT AVAILABLE, APR MODE INHIBITED, PREDICT RAIM ON STA 5.

(1) The approach must be discontinued. The STA 5 page provides a means to predict when RAIM will be available.

To perform a RAIM prediction on the STA 5 page, two pieces of information are needed: the location that the prediction will be for and the time for the prediction.

The destination waypoint will, by default, be the missed approach point of an approach loaded in the flight plan. If there is no approach in the flight plan, the default waypoint is the last waypoint in the active flight plan. It is possible for the pilot to enter any desired waypoint in this field.

The time used for the RAIM prediction will be the current ETA to the destination airport or the MAP. This time is automatically updated by the KLN 90B so there is no need to enter a value. If a RAIM prediction is desired for planning purposes, it is possible to enter a time in this field. The time used for the RAIM prediction is always in the future and is limited to 24 hours from the present time.

To perform a RAIM prediction, perform the following steps.

Use the left outer and inner knobs to select the STA 5 page.

Press the left **CRSR** button. The cursor will be over the DEST field.

If necessary, enter the desired waypoint identifier by using the left inner and outer knobs.

Once the desired waypoint identifier is entered, press the **ENT** button. Press the **ENT** button again if the information is correct.

The cursor will now be over the ETA field. If necessary, use the left inner and outer knobs to enter the desired time and time zone. When the desired time is entered, press the **ENT** button. The RAIM calculations will start. The calculation will usually take a few seconds.

Once the RAIM calculation is complete, the STA 5 page will indicate the results of the test. Refer to Figure 3D-72. This is done graphically in a bar graph. The center of the bar graph represents the ETA. Each bar represents 5 minutes of time. The RAIM calculation is good for ± 15 minutes of the ETA. Bars that are above the line indicate RAIM is available and bars below the line indicate when RAIM is not available.

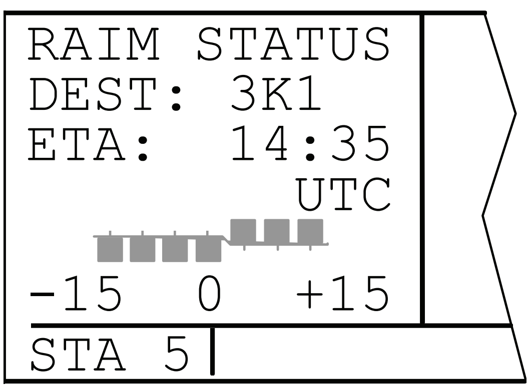


Figure 3D-72. RAIM Status

Even more rare will be the case when the KLN 90B cannot provide sufficient integrity monitoring or if there is an actual satellite failure while the aircraft is on the leg from the FAF to the MAP. In these cases, the KLN 90B will flag the navigation solution and a missed approach will have to be flown. The KLN 90B will provide the following message, PRESS GPS APR FOR NAV.

Press the external **GPS APR** button. This will change the unit to the approach arm mode and navigation information will be restored.

SID/STAR PROCEDURES.

The database contains the pilot's NAV SID's and STAR's for the primary database coverage area. SID/STAR procedures stored in the database can only be considered accurate as long as the database is current. Even though the database contains SID/STAR procedures, there is a lot of information that is not included in the database. Therefore, the paper chart is still the primary source of information. Many procedures require the aircraft to fly at a certain altitude, along a heading until intercepting a course and many other procedures that the KLN 90B cannot automatically accomplish. Many procedures require pilot action to ensure that the proper path is flown over the ground. The main purpose of loading a SID or a STAR into the active flight plan is to provide a quick way of loading a potentially large number of waypoints.

NOTE

There are some SID / STAR procedures that are not suited for the operational characteristics of the KLN 90B. These procedures are not included in the database.

SID and STAR procedures are stored with the airport for which they apply. SID and STAR procedures are accessed through the APT 7 page. If there are both SID's and STAR's for a given airport, there will be two APT 7 pages, one to select a SID and the other to select a STAR. This is indicated by APT+7.

SID and STAR procedures are defined in three parts: the name, the transition, and the runway component. The APT 7 page leads the pilot through the selection process.

Selecting a SID.

11. Select the departure airport APT 7 or ACT 7 page.

Turn the right cursor on by pressing the right **CRSR** button. Rotate the right outer knob until the cursor is over the desired SID. Press the **ENT** button.

The KLN 90B will ask for the runway in use. Position the cursor over the appropriate runway and press the **ENT** button.

The transitions are presented for selection. Move the cursor over the desired transition and press the **ENT** button.

The KLN 90B presents a list of waypoints that make up the SID. Review the waypoints and press the

ENT button, with the cursor over LOAD IN FPL, to load the SID into the active flight plan.

The KLN 90B will add the SID procedure after the airport reference point in the active flight plan. If the airport reference point is not included in the active flight plan, the KLN 90B will ask to add this waypoint to the active flight plan.

Selecting a STAR. Selecting a STAR is very similar to selecting a SID. The only difference is the order of the steps to define the STAR and where the STAR is loaded into the flight plan.

12. Select the APT 7 or the ACT 7 page for the destination airport. Ensure the words SELECT STAR are displayed near the top of the screen.

Turn the right cursor on by pressing the right **CRSR** button, and, if necessary, rotate the right outer knob until the flashing cursor is over the desired STAR. Press the **ENT** button.

The KLN 90B will ask which transition to use.

In some cases, the STAR procedure requires the selection of a specific runway. To select a specific runway, move the cursor over the desired runway and press the **ENT** button.

The KLN 90B presents a list of waypoints that make up the STAR. Review the waypoints and, with the cursor over LOAD IN FPL, press the **ENT** button to load the STAR into the active flight plan.

The KLN 90B will add the STAR procedure before the airport reference point in the active flight plan. If the airport reference point is not included in the active flight plan, the KLN 90B will ask to add this waypoint to the active flight plan.

NOTE

It is not possible to load a SID or a STAR into a flight plan other then FPL 0. SID and STAR procedures are deleted from FPL 0 after the power is off for more than 5 minutes.

Editing a SID or a STAR. SID and STAR procedures have procedure headers. It is possible to use these headers to delete and change the procedure, as is done with approach procedures. Refer to Figure 3D-73. Unlike approaches, it is possible to add and delete waypoints in SID and STAR procedures.

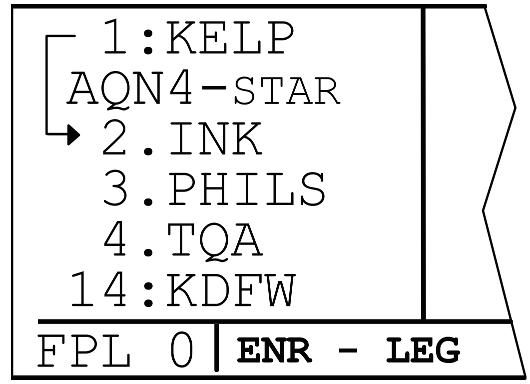


Figure 3D-73. SID/STAR Procedure

To help differentiate between approaches (no adding or deleting waypoints) and SID and STAR procedures (adding and deleting waypoints allowed), the waypoint number is followed by a period (**.**) next to it instead of a blank space. The period also differentiates a SID or STAR waypoint from a regular waypoint, which is followed by a colon (**:**).

Adding an Individual Waypoint in the SID or STAR Procedure.

Use the left knobs to select the FPL 0 page on the left side of the screen.

Turn the left cursor on by pressing the left **CRSR** button. Rotate the left outer knob as necessary to position the cursor over the waypoint identifier which will follow the waypoint being added.

Use the left inner and outer knobs to enter the new waypoint identifier.

Press the **ENT** button to display the waypoint page for this identifier. If the waypoint is correct, press the **ENT** button a second time to confirm the waypoint page. The new waypoint is added to the waypoints that make up the SID or the STAR procedure.

Deleting an Individual Waypoint In a SID or a STAR Procedure.

Use the left knobs to select the FPL 0 page on the left side of the screen.

Rotate the left outer knob to place the cursor over the waypoint to be deleted.

Press the clear button. The letters DEL will appear to the left of the identifier and a question mark will appear to the right of the identifier.

If this is the desired waypoint to delete, press the **ENT** button. If it is not the desired waypoint, press the clear button.

NOTE

Adding waypoints to or deleting waypoints from SID or STAR procedures does not change the way that they are stored in the published database.

Changing or Deleting an Entire SID or STAR Procedure From the Active Flight Plan.

NOTE

Any waypoints manually added to a SID or STAR will be deleted if the SID or STAR is changed or deleted using the following procedure.

Use the left knobs to select the FPL 0 page on the left side of the screen.

Turn the left cursor on by pressing the left **CRSR** button. Move the cursor over the SID or STAR procedure header by using the left outer knob.

With the cursor over the procedure header, press the **ENT** button to change the SID or STAR procedure or press the clear button and then the **ENT** button to delete the entire procedure.

THE OTHER PAGES.

Frequencies for Nearest Flight Service Stations (Other 1). The KLN 90B stores in its database the locations of Flight Service Stations (FSS) and their remote communications sites. In addition, the KLN 90B determines which two of these FSS points of communication are closest to the aircraft position.

NOTE

In some areas of the world the KLN 90B provides the location of the nearest point of communication with a facility providing information (INF) or radio (RDO) services.

Select the OTH 1 page on the left side to view two of the nearest points of communication with FSS. There will normally be two OTH 1 pages, one for each of the two points of contact. The name of the FSS is at the top of the page. There can be from one to four frequencies. Where it is possible to communicate with FSS by transmitting on VHF and receiving on the VOR, the OTH 1 page displays the frequencies to use for transmit and receive and also the name of the VOR being used.

In some parts of the world, HF communications are used for these services. These frequencies are displayed where appropriate.

NOTE

Frequencies for Area Control Centers are displayed on the OTH 2 page for some areas of the world.

Frequencies for Air Route Traffic Control Centers (Other 2). The KLN 90B also stores in its database the low altitude boundries of each of the ARTCC Centers. The KLN 90B determines the proper center to contact and the appropriate frequencies to use for the aircraft's present position. The OTH 2 page is used to display this information.

Deleting User-Defined Waypoints (Other 3). A listing of all user-defined waypoints is contained on the OTH 3 page. The user-defined waypoints are listed by category: airports (A), VOR's (V), NDB's (N), intersections (I), and supplemental (S). Within each category, the waypoints are alphabetized by identifier. To the right of the identifier is the type waypoint. If the waypoint is used in a flight plan, the flight plan number is shown to the right of the waypoint type. Refer to Figure 3D-74. If more than five user waypoints exist, it is necessary to press the left **CRSR** button and then use the left outer knob to scroll through the complete list.

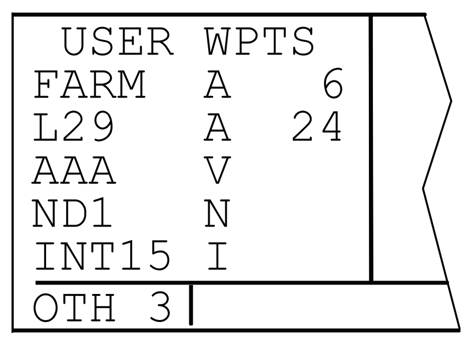


Figure 3D-74. OTH 3 Page

Deleting a User Waypoint.

Select the OTH 3 page.

Press the left **CRSR** button and use the left outer knob to move the cursor over the waypoint to be deleted. If more than five user-defined waypoints exist, it is necessary to use the left outer knob to scroll through the list. A waypoint contained in a flight plan cannot be detected without first either deleting the waypoint from the flight plan or deleting the entire flight plan.

Press the **CLR** button. The waypoint page for the waypoint to be deleted appears on the right side.

Press the **ENT** button.

Press the left **CRSR** button to turn off the left cursor function.

Deleting Airport Remarks (Other 4). The OTH 4 page includes a listing of all airports whose APT 5 pages contain remarks. To delete a previously entered remark, select the OTH 4 page, position the cursor over the desired airport identifier, press the **CLR** button, and then press the **ENT** button. If there are more than five airports with remarks, use the left outer knob to scroll the cursor down the list to find the desired airport identifier.

Fuel Management (Other 5 through 8). The installation of the Army Engine Trend Monitoring System (AETM) allows the KLN 90B to interface with real time fuel management data so that the system can continuously compute the amount of fuel required to reach the destination and the amount of fuel that will be on board upon reaching the destination. The AETM continuously sends the rate of fuel flow to the KLN 90B. The KLN 90B continuously calculates the aircraft's distance, groundspeed, and estimated time en route to the destination waypoint. The fuel required to reach the destination waypoint is the ETE multiplied by the current rate of fuel flow. The amount of fuel remaining at the destination is the amount of fuel presently remaining minus the fuel required to reach the destination.

CAUTION

The KLN 90B fuel calculations are based on the present rate of fuel flow, the present groundspeed, the present distance to the destination airport along the programmed route, and the amount of fuel onboard entered at departure. Before takeoff, the unit must be properly initialized with the amount of fuel on board. Since many factors influence the required amount of fuel to reach the destination, check the fuel pages often for significant changes. Some factors affecting the amount of fuel required are power changes, altitude changes, headwind/tailwind component changes, and routing changes.

OTH 5 Page. The OTH 5 page displays the following information. Refer to Figure 3D-75.

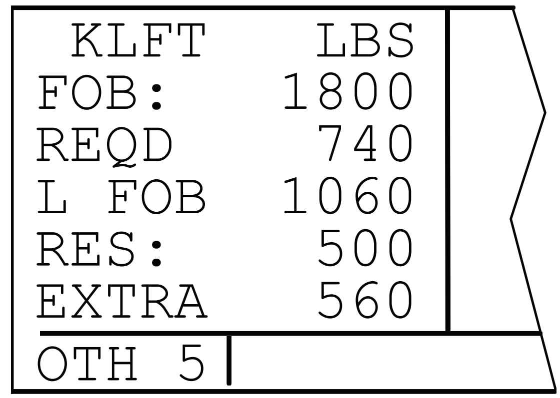


Figure 3D-75. OTH 5 Page

Th*e Destination Waypoint*. An arrow is displayed to the left of the identifier if the waypoint is the active waypoint.

The fuel units as received from the AETM.

T*he Fuel Presently On Board (FOB).* To change the present fuel on board:

Turn to the OTH 5 page.

Press the left **CRSR** button to turn on the cursor function.

Enter the current fuel on board using the left inner and outer knobs.

Turn the cursor function off.

The fuel required to reach the destination waypoint at the current rate of fuel flow and the present groundspeed (REQD).

The landing fuel on board (L FOB) is the original fuel on board minus the total fuel required to reach the destination.

The desired fuel reserve (RES) is the amount of reserve fuel the pilot has entered. The fuel must be entered in the same units displayed on the first line. To enter the reserve, press the left **CRSR** button, rotate the left outer knob to move the cursor over the RES field. Use the left inner and outer knobs to enter the desired fuel quantity. Press the left **CRSR** button to turn off the left cursor function.

The calculated extra fuel (EXTRA) is the landing fuel on board (L FOB) minus the fuel reserve (RES).

OTH 6 Page. The OTH 6 page displays the following. Refer to Figure 3D-76.

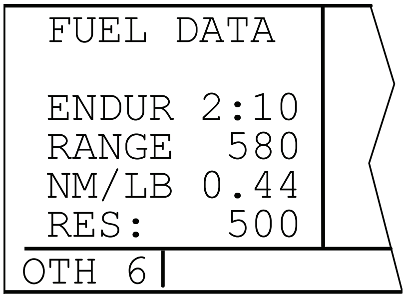


Figure 3D-76. OTH 6 Page

The endurance (ENDUR) in hours and minutes. The endurance is calculated based on the amount of fuel remaining after subtracting out the reserve (RES) entered on the OTH 5 page or the OTH 6 page from the present fuel on board.

The range (RANGE), which is the distance in nautical miles that could be flown based on the endurance calculated above and the present groundspeed.

The fuel efficiency, which is the groundspeed divided by the present fuel flow.

The desired fuel reserve (RES). Same as displayed on the OTH 5 page. Changing the reserve on one of the two pages also changes it on the other page.

OTH 7 Page. The OTH 7 page displays rate of fuel flow as depicted in Figure 3D-77.

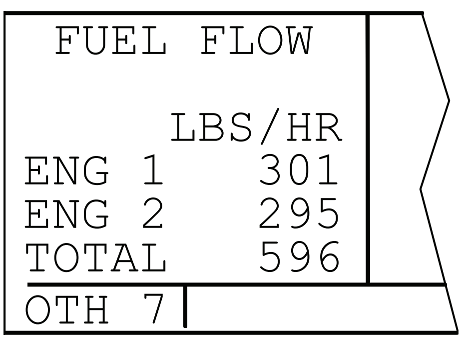


Figure 3D-77. OTH 7 Page

OTH 8 Page. The OTH 8 page displays the amount of fuel used as depicted in Figure 3D-78.

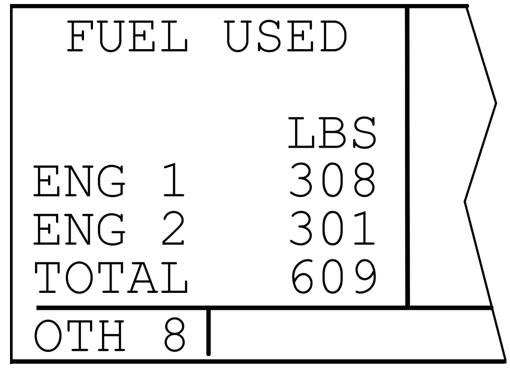


Figure 3D-78. OTH 8 Page

The Air Data Pages. When interfaced with the AETM, the KLN 90B will display real time air data parameters such as True Airspeed (TAS), Static Air Temperature (SAT), Total Air Temperature (TAT), Mach number, density altitude, and pressure altitude. The KLN 90B will also calculate and display real time wind data (magnitude and direction). The OTH 9 and OTH 10 pages are used to display air data information.

Figure 3D-79 depicts the OTH 9 page display.

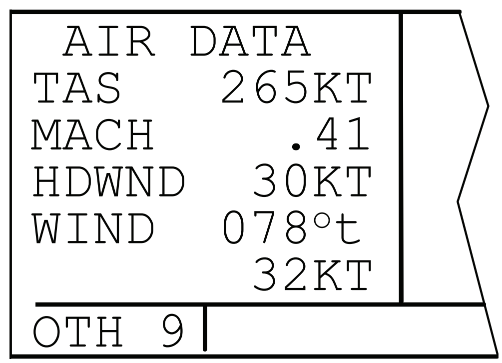


Figure 3D-79. OTH 9 Page

NOTE

These air data pages receive inputs from air data sensors and display real time air data information. They are independent of the calculator pages that rely on manual pilot inputs to calculate air data information.

The TAS of the aircraft through the surrounding air mass.

MACH – the ratio of the true airspeed to the speed of sound at a particular flight condition.

The Tailwind (TLWND) component of the wind, if applicable.

The (HDWND) component of the wind, if applicable.

The Wind (WIND) direction relative to true North and the wind speed.

OTH 10 Page. The OTH 10 page displays the following information.

SAT – the actual temperature of the surrounding air.

TAT – the air temperature including heat rise due to compressibility. This is the temperature measured directly by the OAT probe.

Pressure altitude (PRS) to the nearest 100 feet.

Density altitude (DEN) to the nearest 100 feet.

THE SETUP PAGES.

The Setup 0 Page. The SET 0 page is used for computer updating of the database. Update information is sent on 3.5-inch disks. A computer is used via the data loader jack installed in the instrument panel. This is normally a maintenance function.

CAUTION

The KLN 90B does not perform any navigation functions while the database is being uploaded.

NOTE

The disks can only be used to update one KLN 90B, although they can be used to update a specific unit numerous times. The first time the disks are used in an update operation, a unique identification code from the KLN 90B being used is uploaded to the disks. These disks may be used in this specific KLN 90B an unlimited number of times if switching between the North American and International data-bases occurs during one update cycle. These disks, however, may not be used to update other KLN 90B's. This update protection ensures that Jeppesen Sanderson is properly compensated for their NavData™.

The Setup 1 Page. The Setup 1 page is used to manually update the position of the KLN 90B and enter a groundspeed for use of the KLN 90B in the take home mode. Refer to Figure 3D-80. Since the KLN 90B stores its position and other required parameters in memory when power to the unit is removed, it is seldom necessary to aid the unit in reaching a NAV ready status. In order for the unit to reach a NAV ready condition, it is necessary to meet the same conditions outlined in Paragraph 3D-7, Initialization.

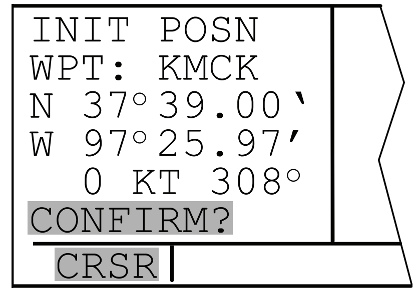


Figure 3D-80. Setup 1 Page

The KLN 90B's almanac data must be current. Almanac data is crude orbital information for all the satellites and is used for initial acquisition when the unit is first turned on. This data is stored in the KLN 90B's nonvolatile memory and is considered current up to 6 months. Each satellite sends almanac data for all satellites. Since the KLN 90B routinely updates the almanac data during normal operation, the almanac data will become out of date only if the KLN 90B hasn't been used for the previous 6 months or longer. Collecting new almanac data takes place automatically if the data is more than 6 months old. This will usually take about 6 minutes, but no more than 12 minutes.

The aircraft must be located so the GPS antenna has an unobstructed view of the sky.

It is very helpful for the KLN 90B to have the correct date, time, and position. This information is stored in the battery-backed memory of the KLN 90B, so it is not normally required to update it. If acquisition time is not important, it is not necessary to update the date, time, and position.

Select the Setup 1 page by turning the left outer knob to **SETUP,** displaying a SET page annunciated in the lower left segment of the display. Next, turn the left inner knob until the SET 1 page is selected.

Press the left **CRSR** button to bring the cursor on the page over the **WPT** field.

NOTE

As an alternative, the latitude and longitude of the present position can be entered directly instead of entering a waypoint identifier.

Use the left inner knob to enter characters and the left outer knob to move the cursor until the identifier for the location is entered.

Press the **ENT** button to view the waypoint page on the right side.

Press the **ENT** button again to approve the entry.

Use the left outer knob to position the cursor over CONFIRM?.

Press the **ENT** button.

NOTE

The groundspeed and heading fields are not used for initialization in the aircraft. If the KLN 90B is in the take-home mode, entering a groundspeed will allow the KLN 90B to fly along the active flight plan (or direct to a waypoint) starting from the initialization waypoint. A heading may be entered in the initial heading field while in the take-home mode if the one offered is not desired. If the take-home mode is used, the KLN 90B must be initialized to the aircraft's location when it is reinstalled.

Use the left knobs to select the NAV 2 page. When the KLN 90B reaches the NAV ready status and is able to navigate, the NAV 2 page will display the present position. Verify the latitude and longitude or the VOR radial and distance displays are correct.

The Setup 2 Page. Refer to Figure 3D-81 for a sample page. The KLN 90B's system time and date should seldom require updating because they are automatically updated when at least one satellite is received. In addition, the KLN 90B contains an internal battery powered calendar clock to keep system time and date when the unit is not being used. The correct time and date are normally confirmed on the Self-Test page, but the Setup 2 page can also be used.

NOTE

The time and date cannot be changed if the KLN 90B is receiving time and date from a satellite.

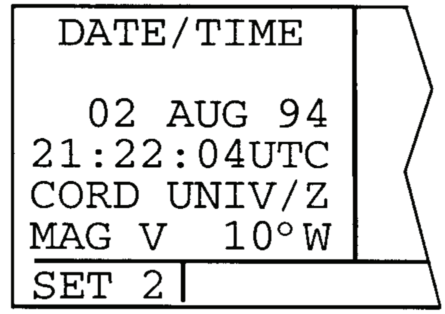


Figure 3D-81. SET 2 Page - Set Date

Date.

Select the SET 2 page on the left side.

Press the left CRSR button to turn on the left cursor function. The cursor will be over the entire date.

Rotate the left inner knob to select the correct day.

Turn the left outer knob one step clockwise to position the flashing part of the cursor over the month.

Rotate the left inner knob to select the correct month.

Turn the left outer knob one step clockwise to position the cursor over the tens digit of the year.

Use the left inner knob to select the correct tens digit of the year.

Turn the left outer knob one step clockwise to position the cursor over the remaining position of the year.

Use the left inner knob to complete the year.

Press the **ENT** button to start the KLN 90B using the new date.

Time.

Select the SET 2 page on the left side. Refer to Figure 3D-82.

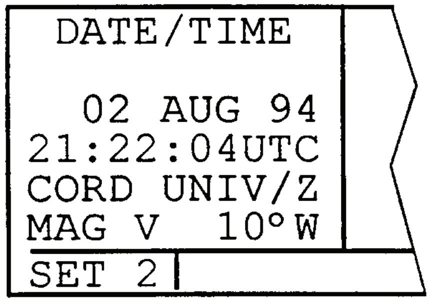


Figure 3D-82. SET 2 Page - Set Time

Press the left **CRSR** button to turn on the left cursor function. The cursor will be over the entire date.

Use the left outer knob to position the cursor over the time zone.

Use the left inner knob to select the desired time zone.

Turn the left outer knob one step counterclockwise to position the cursor over the time.

Rotate the left inner knob to select the correct hour (24-hour time).

Turn the left outer knob one step clockwise to position the flashing part of the cursor over the tens position of the minute, and then use the left inner knob to select the correct value.

Turn the left outer knob one step clockwise to position the cursor over the remaining minute's position, and then use the left inner knob to complete the time selection.

Press the **ENT** button to start the clock running.

Press the left **CRSR** button to turn off the left cursor function.

The KLN 90B's primary coverage area is from N74° to S60° latitude. All navigation data presented outside this area is automatically reference to true North unless a manual input of magnetic variation is made on the SET 2 page. The same is true anytime the KLN 90B is in the OBS mode and the active waypoint is outside the primary coverage area. Under both of these conditions, the following message will be displayed on the message page, MAGNETIC VAR INVALID – ALL DATA REFERENCED TO TRUE NORTH.

When navigation is within the primary coverage area, the SET 2 page does not display magnetic variation. However, under the above conditions, a user-entered magnetic variation may be made on line 6 of the SET 2 page using the left **CRSR** button and the left inner and outer knobs.

The Setup 3 Page. The nine airports in the nearest list are the nine airports that meet the criteria selected on the SET 3 page. Refer to Figure 3D-83.

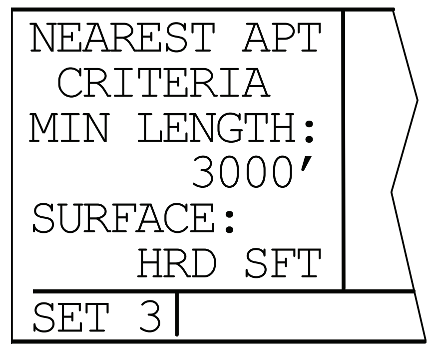


Figure 3D-83. SET 3 Page

Select the SET 3 page on the left side.

Press the left **CRSR** button to turn on the left cursor function. The cursor will appear over the minimum runway length.

Use the left inner knob to select the minimum length runway desired for the airport to qualify for the nearest airport list. Values between 1000 feet and 5000 feet in 100-foot increments may be used.

Rotate the left outer knob one step clockwise to position the cursor over the runway surface criteria.

Turn the left inner knob to select either HRD SFT or HRD. If HRD SFT is chosen, both hard and soft surface runways meeting the required runway length will be included in the nearest airport list. If HRD is chosen, only hard surface runways will be included. Hard surface runways include concrete, asphalt, pavement, tarmac, brick, bitumen, and sealed. Soft surface runways include turf, gravel, clay, sand, dirt, ice, steel matting, shale, and snow.

The Setup 4 Page. The SET 4 page is used to define the departure time. Refer to Figure 3D-84.

Select the SET 4 page.

Turn on the left cursor function.

Use the left inner knob to select between RUN WHEN GS > 30KT or RUN WHEN POWER IS ON.

Turn off the left cursor function.

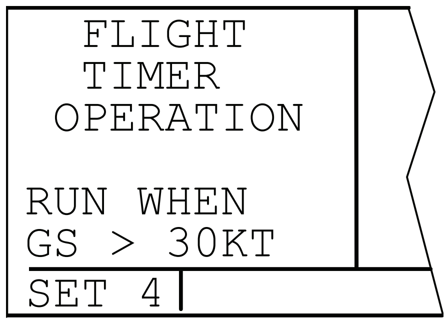


Figure 3D-84. SET 4 Page

The Setup 5 Page. The height above airport feature provides an altitude alert annunciator when the aircraft has reached a selected altitude above the airport. This feature is enabled/disabled on the SET 5 page. Refer to Figure 3D-85. The altitude is also selected on the SET 5 page.

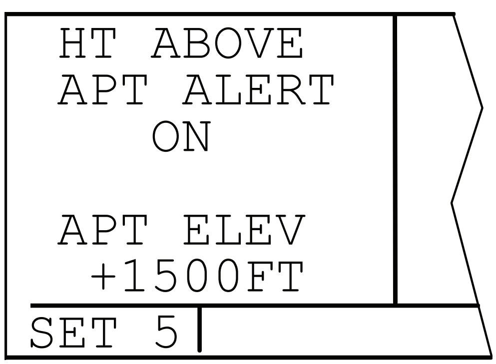


Figure 3D-85. SET 5 Page

WARNING

The height above airport alert feature does not serve the same function as a radar altimeter. It does not provide any warning about the aircraft's actual height above the airport's surrounding terrain.

CAUTION

The height above airport alert feature will only be accurate if the barometric altimeter setting is correct. If the height above airport function is enabled, in the C-12F3 ensure the barometric altimeter setting is correct on the ALT page.

When the height above airport is enabled, the KLN 90B creates a 5-nm radius cylinder of airspace centered on an airport. This airport is any airport that is a direct to waypoint or is the to waypoint in the active flight plan. The height of the cylinder above the airport is the height selected on the SET 5 page. The KLN 90B adds the selected altitude to the elevation stored in the database for the airport. The KLN 90B provides an altitude alert light when the aircraft first penetrates the cylinder.

To enable or disable the height above the airport alert, press the left **CRSR** button. Use the left outer knob to position the cursor over the enable/disable field. Turn the left inner knob to select **ON** or **OFF**. To select the height, use the left outer knob to position the cursor over the altitude field. Turn the left inner knob to select an offset between 800 and 2000 feet. Press the left **CRSR** button to turn off the cursor function.

The Setup 6 Page. Turn anticipation may be enabled or disabled on the SET 6 page. Refer to Figure 3D-86. Turn on the left cursor function and use the left inner knob to select between ENABLE or DISABLE. If turn anticipation is disabled, navigation is provided all the way to the waypoint and waypoint alerting occurs approximately 36 seconds prior to actually reaching the waypoint.

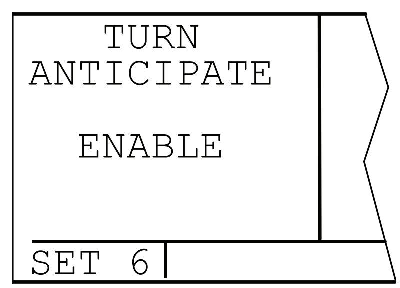


Figure 3D-86. SET 6 Page

The Setup 7 Page. The SET 7 page is used to select whether the altimeter setting used in the KLN 90B is made in inches of Mercury or millibars. Refer to Figure 3D-87. To change the altimeter setting between inches of Mercury and millibars, select the SET 7 page, press the left **CRSR** button, and rotate the left inner knob to make the selection. When finished, press the left **CRSR** button to turn off the cursor function.

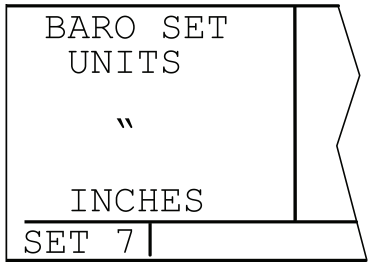


Figure 3D-87. SET 7 Page

The Setup 8 Page. The Special Use Airspace (SUA) alert feature may be enabled or disabled on the SET 8 page. Refer to Figure 3D-88. After displaying the SET 8 page on the left side, press the left **CRSR** button to turn on the left cursor function. The left inner knob is used to display AIRSPACE ALERT ENABLE or AIRSPACE ALERT DISABLE. If the SUA feature has been enabled, the KLN 90B allows the selection of a vertical buffer in order to provide a vertical warning of SUA. To select a vertical buffer, ensure the SUA feature has been enabled. Press the left **CRSR** button to turn on the left cursor and then use the left outer knob to move the cursor over the first position of the vertical buffer. Use the left inner knob to select each number and the left outer knob to position the cursor. The buffer may be selected in 100-foot increments. After the desired selection has been made, press the left **CRSR** button to turn off the cursor function.

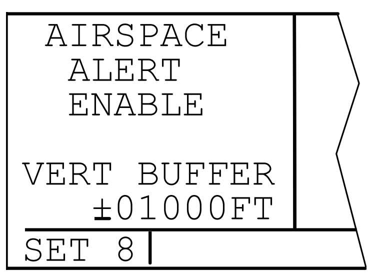


Figure 3D-88. SET 8 Page

The Setup 9 Page. There are aural alarms associated with the KLN 90B and the volume is set on this page.

THE TRIP PLANNING PAGES.

There are seven trip planning pages (TRI) that can be displayed on the left side of the screen. The TRI 1 and 2 pages team together to provide trip planning from the present position to a selected waypoint. The TRI 3 and 4 pages provide trip planning between any two selected waypoints. The TRI 5 and 6 pages provide an analysis of any of the 26 flight plans in the flight plan pages.

Data entered on any of the trip planning pages have no effect on the navigation data provided on any navigation or flight plan page.

NOTE

The trip planning pages rely on pilot-entered inputs for true airspeed, groundspeed, and fuel flow. These pages do not utilize inputs from the fuel flow or air data sensors, if installed.

Areas of special use airspace are displayed on the trip planning pages without regard to altitude.

The Trip Planning 0 Page. The anticipated true airspeed and winds aloft are entered on the TRI 0 page so this information may be used on the other trip planning pages. Refer to Figure 3D-89.

Entering Data.

Select the TRI 0 page on the left side.

Press the left **CRSR** button to turn on the cursor function.

Enter the TAS by using the left outer knob to move the cursor over the TAS field and the left inner knob to select each digit.

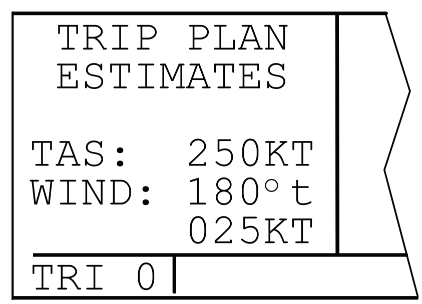


Figure 3D-89. Trip Planning 0 Page

Rotate the left outer knob clockwise to position the cursor over the first two digits of the wind direction.

Turn the left inner knob to select the first two digits of the wind direction.

Rotate the left outer knob one step clockwise to position the cursor over the last digit of the wind direction. Use the left inner knob to complete the wind direction entry.

Enter the wind speed by using the left outer knob to move the cursor and the left inner knob to select each digit.

Press the left **CRSR** button to turn off the cursor function.

The Trip Planning 1 and 2 Pages. The TRI 1 and 2 pages allow trip planning from the aircraft's present position to any selected waypoint. Unlike the other trip planning pages, in order to use the TRI 1 and 2 pages, the KLN 90B must either be receiving GPS signals sufficient to be in the NAV ready status or be in the take home mode.

The TRI 1 page provides estimates of distance, estimated time in route, bearing, and fuel requirements. Refer to Figure 3D-90.

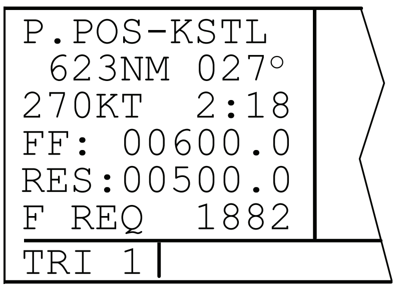


Figure 3D-90. TRI 1 Page

The TRI 2 page displays the minimum En route Safe Altitude (ESA) and any areas of special use airspace that are between the present position and the selected waypoint. Refer to Figure 3D-91.

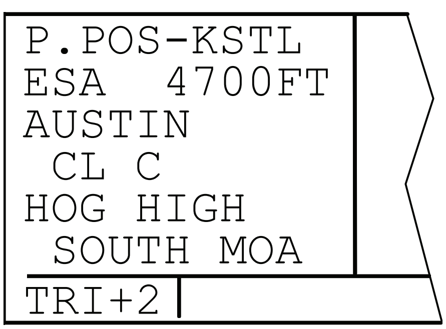


Figure 3D-91. TRI 2 Page

NOTE

Prior to using the TRI 1 and 2 pages while the KLN 90B is in the take home mode, use the SET 1 page to enter the present position.

Trip Planning on the TRI 1 and 2 Pages.

Use the left outer knob to select the TRI type pages.

Rotate the left inner knob to select the TRI 1 page.

Press the left **CRSR** button to turn on the left cursor function. The cursor will be over the waypoint identifier at the top of the page.

Use the left inner and outer knobs to enter the identifier of the selected waypoint.

Press the **ENT** button to view the waypoint page for the selected waypoint on the right side.

Press the **ENT** button again to acknowledge the waypoint page. The distance, bearing, and estimated time en route are now displayed.

If true airspeed and wind information were entered on the TRI 0 page, the groundspeed displayed is a result of those inputs applied to the direction of flight specified on the TRI 1 page. A different groundspeed may be entered by using the left outer knob to position the cursor over each digit of the groundspeed and using the left inner knob to select each individual digit.

Calculate an estimate of the fuel required to the selected waypoint. Turn the left outer knob to position the cursor over the appropriate first digit adjacent to the Fuel Flow (FF).

Use the left inner and outer knobs as before to enter the aircraft's rate of fuel flow. The unit (gallons, pounds, etc.) is not important as long as all entries are in the same unit.

Use the left inner and outer knobs to enter the amount of reserve fuel (RES) desired upon arrival at the destination waypoint. The estimated amount of fuel required (F REQ) to fly to the selected waypoint with the specified reserve is now displayed. Entering the fuel flow and reserve fuel on the TRI 1 page also inputs this same information on the TRI 3 and 5 pages.

10. Press the left **CRSR** button to turn off the left cursor function.

11. Select the TRI 2 page. The minimum ESA and a listing of areas of special use airspace along the route are displayed. If all the areas of special use airspace won't fit on one page, there will be multiple TRI 2 pages indicated by TRI+2, as illustrated in Figure 3D-91.

b. The Trip Planning 3 and 4 Pages. The TRI 3 and 4 pages allow trip planning between any two waypoints. The KLN 90B does not have to be receiving GPS signals to use these pages.

1. Select the TRI 3 page on the left side.

2. Press the left **CRSR** button to turn on the left cursor function. The cursor will be located over the From waypoint.

3. Use the left inner and outer knobs to enter the identifier of the From waypoint.

4. Press the **ENT** button to view the waypoint page on the right side for the waypoint just entered.

5. Press the **ENT** button again to approve the waypoint page. The cursor will position over the to waypoint identifier.

6. Use the left inner and outer knobs to enter the identifier of the to waypoint.

7. Press the **ENT** button to view the waypoint page on the right side for the waypoint just entered.

8. Press the **ENT** button to approve the waypoint page. The distance, bearing, and estimated time en route are now displayed, as shown in Figure 3D-92.

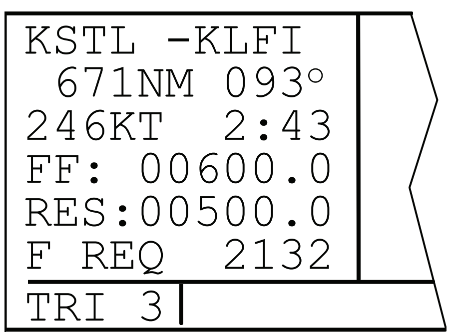


Figure 3D-92. TRI 3 Page

If true airspeed and wind information were entered on the TRI 0 page, the groundspeed displayed is a result of those inputs applied to the direction of flight specified on the TRI 3 page. A different groundspeed may be entered by using the left outer knob to position the cursor over each digit of the groundspeed and using the left inner knob to select each individual digit.

If data is entered for FF and RES, as described for the TRI 1 page, the fuel required for the trip is now displayed. Fuel flow and reserve fuel entries made on the TRI 3 page also input this same data on the TRI 1 and the TRI 5 pages.

b. Turn off the cursor function and select the TRI 4 page. The minimum ESA and a listing of areas of special use airspace along the route are displayed. Refer to Figure 3D-93. If all the areas of special use airspace won't fit on one page, there will be multiple TRI 4 pages indicated by TRI+4.

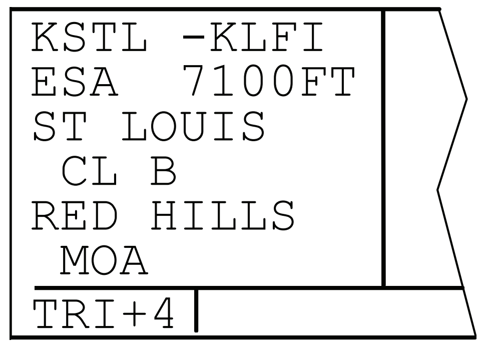


Figure 3D-93. TRI 4 Page

c. The Trip Planning 5 and 6 Pages. The TRI 5 and 6 pages are used to do trip planning for any one of the previously entered flight plans. The KLN 90B does not have to be receiving GPS signals in order to use these pages.

1. Select the TRI 5 page on the left side. Refer to Figure 3D-94.

2. Press the left **CRSR** button to turn on the left cursor function.

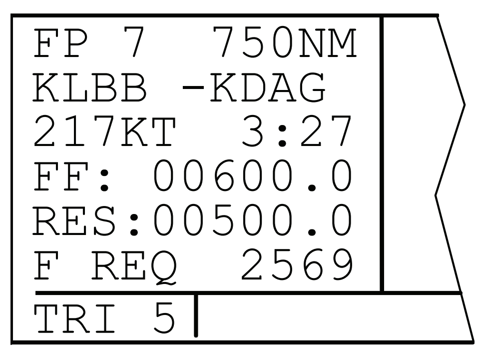


Figure 3D-94. TRI 5 Page.

3. Rotate the left inner knob to select the desired flight plan. The first and last waypoints in the selected flight plan are displayed on the second line. The

distance and the estimated time en route are also displayed. There is no bearing displayed since a flight plan can have up to 30 waypoints that create 29 flight plan legs.

If true airspeed and wind information were entered on the TRI 0 page, the groundspeed displayed is the average groundspeed for the flight plan. It is the result of those inputs applied to each leg of the flight plan. A different groundspeed may be entered by using the left outer knob to position the cursor over each digit of the groundspeed and using the left inner knob to select each individual digit.

If data is entered for FF and RES, as described for the TRI 1 page, the fuel required for the trip is now displayed. Fuel flow and reserve fuel entries made on the TRI 5 page also input this same data on the TRI 1 and the TRI 3 pages.

4. Turn off the cursor function and then select the TRI 6 page. The minimum ESA and a listing of areas of special use airspace of special use airspace won't fit on one page, there will be multiple TRI 6 pages indicated by TRI+6. Refer to Figure 3D-95.

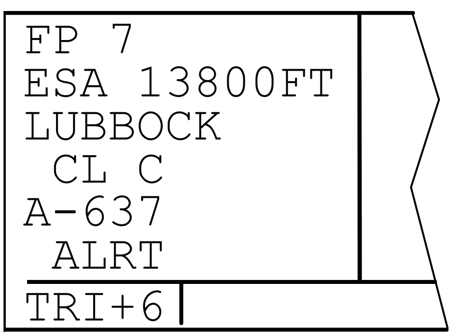


Figure 3D-95. TRI 6 Page

3D-2. THE CALCULATOR PAGES.

The are seven calculator pages which may be used to calculate a variety of information such as pressure altitude and density altitude, true airspeed, winds aloft, VNAV angle, and time zone conversions. The calculator pages rely on manual inputs of air data parameters even if the KLN 90B is interfaced with air data sensors.

a. The Calculator 1 Page. The CAL 1 page is used to determine pressure altitude and density altitude.

1. Display the CAL 1 page on the left side.

2. Press the left **CRSR** button to turn on the left cursor function.

3. Enter the altitude indicated on the aircraft altimeter (IND) to the nearest hundred feet by using the left outer knob to move the cursor to the desired position and the left inner knob to select each digit.

4. Use the left outer knob to move the cursor to the first BARO position, and then enter the current altimeter setting by using the left inner and outer knobs. The pressure altitude (PRS) is now displayed.

5. Use the left outer knob to move the cursor to the first TEMP position, and then enter the outside air temperature (in °C) by using the left inner and outer knobs. The first digit of the temperature is either zero if the temperature is above zero or a minus (–) if the temperature is below zero. For maximum accuracy, the static air temperature should be entered. This is the temperature of the air without the effect of heating due to movement through the air. The density altitude (DEN) is now displayed as illustrated in Figure 3D-96.

6. Press the left **CRSR** button to turn off the left cursor function.

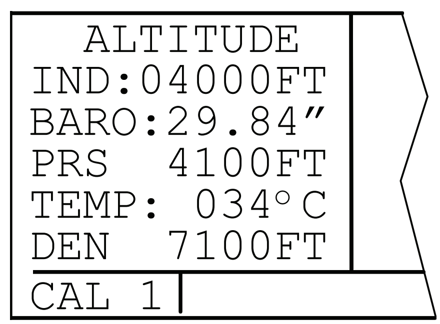


Figure 3D-96. CAL 1 page

NOTE

If the AETMS is installed and interfaced to the KLN 90B, the OTH 10 page displays pressure altitude and density altitude for the present conditions.

b. The Calculator 2 Page. The CAL 2 page is used to determine TAS.

1. Select the CAL 2 page on the left side.

2. Press the left **CRSR** button to turn on the cursor function.

3. Enter the aircraft's calibrated airspeed by using the left inner and outer knobs. If calibrated airspeed isn't known, use the indicated airspeed.

4. Use the left outer knob to move the cursor to the first ALT position, and then enter the indicated altitude using the left inner and outer knobs. If the indicated altitude was previously entered on the CAL 1 page, it will already be displayed.

5. Turn the left outer knob to move the cursor to the first BARO position and then enter the current altimeter setting using the left inner and outer knobs. If the altimeter setting was made on the CAL 1 page, it will already be displayed.

6. Rotate the left outer knob to move the cursor to the first TEMP position, and then enter the outside air temperature (in ºC) by using the left inner and outer knobs. The first digit of the temperature is either zero (0) if the temperature is above zero or a minus (-) if the temperature is below zero. For maximum accuracy, the total air temperature should be entered. This is the temperature of the air including the effect of heating due to movement through the air. Because of the two types of temperature, a temperature entry made on the CAL 1 page is not transferred to the CAL 2 page. The TAS is now displayed as illustrated in Figure 3D-97.

7. Press the left **CRSR** button to turn off the left cursor function.

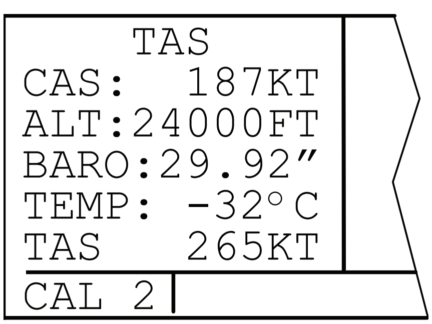


Figure 3D-97. CAL 2 Page

NOTE

If the AETMS is installed and interfaced to the KLN 90B, the OTH 9 page displays the TAS for the present conditions.

c. The Calculator 3 Page. The CAL 3 page is used to calculate the wind direction and speed. In addition, the headwind or tailwind component of the wind is displayed. Refer to Figure 3D-98.

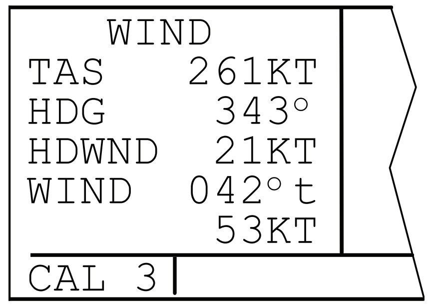


Figure 3D-98. CAL 3 Page

1. Select the CAL 3 page on the left side.

2. Press the left **CRSR** button to turn on the cursor function.

3. Enter the TAS by using the left inner and outer knobs. If the CAL 2 page was previously used to calculate the TAS, it will already be displayed.

4. Use the left outer knob to move the cursor to the first HDG position, and then enter the aircraft's heading using the left inner and outer knobs. The headwind (HDWND) or tailwind (TLWND) and the wind direction and speed are now displayed. The wind direction is relative to true North.

5. Press the left **CRSR** button to turn off the cursor function.

NOTE

Wind calculations are only correct when an accurate heading and true airspeed have been entered.

If the KLN 90B is interfaced with the AETMS, line three of the CAL 3 page is blank. Heading is automatically inputted and used in the wind calculation.

If the KLN 90B is interfaced with the AETMS, the OTH 9 page displays present wind information directly.

d. The Calculator 4 page. The CAL 4 page is used to determine vertical navigation descent/ascent angles to use on the NAV 4 page. Refer to Figure 3D-99.

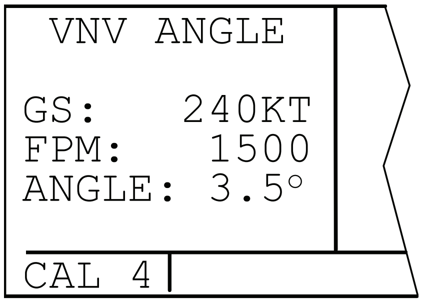


Figure 3D-99. CAL 4 Page

1. Select the CAL 4 page on the left side.

2. Press the left **CRSR** button to turn on the cursor function.

3. Use the left inner and outer knobs to enter what the aircraft's groundspeed will be during the descent or ascent.

4. Turn the left outer knob to move the cursor to the first FPM position, and then enter the desired rate of descent or ascent (in feet per minute) using the left inner and outer knobs. The descent/ascent angle is now displayed. In addition, an angle may be entered and the angle will be determined.

5. Press the left **CRSR** button to turn off the cursor function.

e. The Calculator 5 Page. The CAL 5 page is used to perform two types of conversions: between ºC and ºF and between knots and miles per hour. Refer to Figure 3D-100.

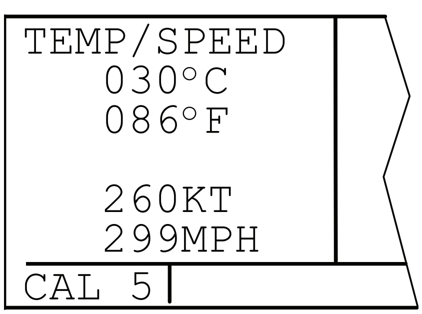


Figure 3D-100. CAL 5 Page

1. Display the CAL 5 page on the left side.

2. Press the left **CRSR** button to turn on the left cursor function.

3. To convert ºC to ºF, use the left outer knob to position the cursor over the appropriate Celsius digits and use the left inner knob to select the desired values. When the desired temperature in ºC is selected, the corresponding temperature in ºF is displayed.

4. To convert ºF to ºC, use the left outer knob to position the cursor over the appropriate Fahrenheit digits and use the left inner knob to select the desired values. When the desired temperature in ºF is selected, the corresponding temperature in ºC is displayed.

5. To convert knots to miles per hour, use the left outer knob to position the cursor over the appropriate knots digits and use the left inner knob to select the desired values of speed. When the desired speed in knots is selected, the corresponding speed in miles per hour is displayed.

6. To convert miles per hour to knots, use the left outer knob to position the cursor over the appropriate miles per hour digits and use the left inner knob to select the desired values of speed. When the desired speed in miles per hour is selected, the corresponding speed in knots is displayed.

7. Press the left **CRSR** button to turn off the left cursor function.

f. The Calculator 6 Page. The CAL 6 page is used to convert any time in one time zone to the corresponding time in another time zone. Refer to Figure 3D-101.

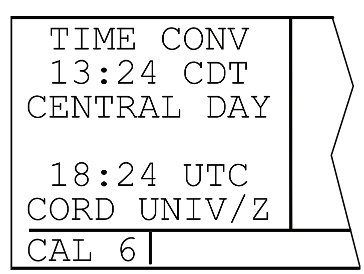


Figure 3D-101. CAL 6 Page

NOTE

You may enter a time different than the actual time in either the top or bottom time display. When either the top or bottom time is changed, the other one also changes to show the correct corresponding time.

1. Select the CAL 6 page on the left side. The first time the CAL 6 page is viewed after the KLN 90B has been turned on, the top time showing will be the current system. It will be the same time displayed on the SET 2 page. The bottom time will be the current time referenced to the Coordinated Universal Time (UTC) time zone.

2. Press the left **CRSR** button to turn on the left cursor function.

3. Rotate the left outer knob to position the cursor over the top time zone abbreviation.

4. Turn the left inner knob to select the desired time zone.

5. Rotate the left outer knob to position the cursor over the bottom time zone abbreviation and use the left inner knob to select the desired time zone. The corresponding time is now displayed.

6. Press the left **CRSR** button to turn off the cursor function.

g. The Calculator 7 Page. The CAL 7 page is used to display the times of sunrise and sunset for any waypoint in the published or user database. Refer to Figure 3D-102. It can do this for any date up to 31 December 2087.

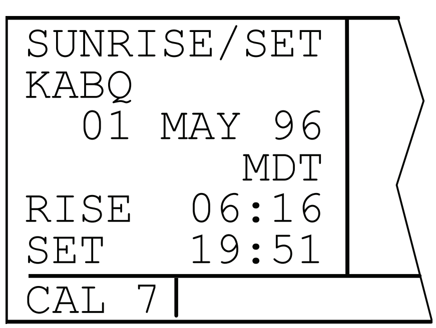


Figure 3D-102. CAL 7 Page

1. Select the CAL 7 page on the left side. The first time the CAL 7 page is selected after the KLN 90B is turned on, the waypoint identifier defaults to the current destination, the date defaults to the current date, and the time zone defaults to the system time zone. Each of these three items may be changed. The sunrise and sunset are displayed at the bottom of the page.

NOTE

The time zone initially displayed is the system time zone. This is the same as the one displayed on the SET 2 page. Note that the time zone displayed may not be appropriate for the waypoint shown.

2. Press the left **CRSR** button to turn on the cursor function.

3. If desired, select another waypoint identifier using the left inner and outer knobs. Press the **ENT** button to view the waypoint page for the waypoint entered. Press the **ENT** button again to approve the waypoint page.

4. If desired, select another date using the left inner and outer knobs. Press the **ENT** button to enter the date.

5. If desired select, another time zone. The sunrise and sunset times for the selected waypoint, date, and time zone are now displayed.

6. Press the left **CRSR** button to turn off the cursor function.

3D-3. WAYPOINTS.

a. Reference Waypoints. Creating a reference waypoint is a method of adding a waypoint to any flight plan. The reference waypoint lies on the great circle route between two other waypoints in the flight plan. The point where the reference waypoint lies on the great circle route is the point where the route passes closest to a pilot designated point. Refer to Figure 3D-103.

NOTE

The waypoint that is used to create the reference waypoint may be in the published or user database. This waypoint must be located relative to the flight plan such that it is possible to draw a perpendicular line from this waypoint to a segment of the flight plan.

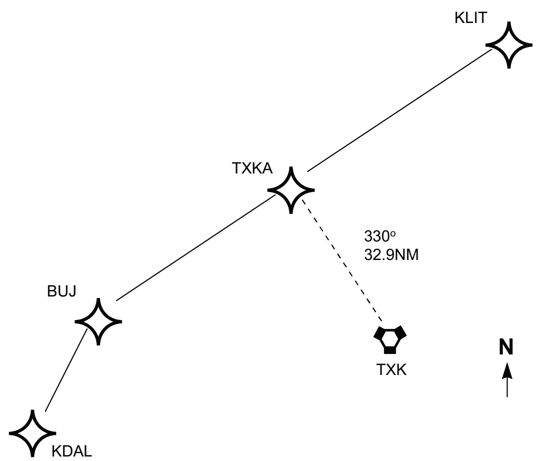


Figure 3D-103. Pilot Designated Point

1. Select the reference waypoint page (REF) on the right side. Refer to Figure 3D-104. If a flight plan page is not displayed on the left side, the REF page displays, DISPLAY DESIRED – FPL ON – LEFT PAGE.

```
USE? INVRT? |
  1:KDAL    |
  2:BUJ     | ENTER REF
  3:KLIT    | WPT:
  4:        |
FPL 2 | ENR - LEG | REF
```

Figure 3D-104. Reference Waypoint

2. Display the desired flight plan on the left side. The reference feature may be used on the active flight plan or on any of the 25 numbered flight plans that contain at least two waypoints.

3. Press the right **CRSR** button to turn on the right cursor function.

4. Use the right inner and outer knobs to enter the identifier of the desired waypoint. Refer to Figure 3D-105.

```
USE? INVRT? |
  1:KDAL    |
  2:BUJ     | ENTER REF
  3:KLIT    | WPT:  TXK
  4:        |
FPL 2 | ENR - LEG  ENT | CRSR
```

Figure 3D-105. Desired Waypoint

5. Press the **ENT** button to display the waypoint page for the waypoint just entered.

6. Press the **ENT** button again to display the waypoint page for the newly created reference waypoint. The waypoint that was used to create the reference waypoint is automatically inserted into the REF field. The radial and distance as well as the latitude and longitude are also displayed. The left side of the screen shows where the reference waypoint will be inserted in the flight plan.

The KLN 90B automatically names the reference waypoint by appending the first available alphabetic character to the identifier of the waypoint used to define the reference waypoint. TXK becomes TXKA, etc. Refer to Figure 3D-106. If TXK is used again to create a second reference waypoint in another flight plan, this second reference waypoint would be named TXKB. If a reference waypoint is created using a waypoint with a five-character identifier, the fifth character will be dropped, e. g., DUSTT becomes DUSTA.

```
USE? INVRT? |  TXKA
  1:KDAL    | REF:  TXK
  2:BUJ     | RAD: 330.3°
  3:TXKA    | DIS: 32.8NM
  4:KLIT    | N 34°01.08'
  5:        | W 94°19.67'
CRSR | ENR - LEG  ENT | SUP
```

Figure 3D-106. Reference Waypoint Name

7. Press the **ENT** button once again to approve the waypoint page for the reference waypoint and insert it into the flight plan.

8. Press the right **CRSR** button to turn off the right cursor function.

A reference waypoint is stored as a supplemental waypoint and counts as one of the 250 possible user-defined waypoints. Reference waypoints that are part of a flight plan show up on the listing of user-defined waypoints displayed on the OTH 3 page. However, reference waypoints that are no longer part of a flight plan are deleted from the list of user-defined waypoints when the KLN 90B is turned off.

b. Center Waypoints. Like reference waypoints, creating center waypoints is a method of adding waypoints to a flight plan. Center waypoints are waypoints at locations where a flight plan intersects the Center or FIR boundary. Placing waypoints on the boundaries results in the minimum number of waypoints required to meet the criteria of having one waypoint in each Center's airspace. The Center boundaries are stored in the database.

(1) Creating Center Waypoints.

1. Select the Center Waypoint 1 (CTR 1) page on the right side. If a flight plan page is not being displayed on the left side, the CTR 1 page will display, DISPLAY DESIRED – FPL ON – LEFT PAGE.

2. Select the desired flight plan page on the left side. It may be the active flight plan or one of the other 25 numbered flight plans.

3. Press the **ENT** button to compute the Center waypoints. Refer to Figure 3D-107. A Center waypoint will be created at each intersection of the flight plan with a center boundary. When computation is complete, the CTR 1 page will display how many Center waypoints have been computed. Refer to Figure 3D-108.

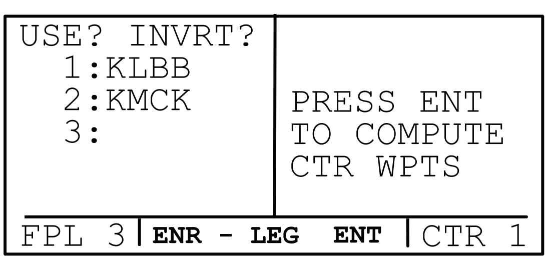


Figure 3D-107. CTR 1 Page – Computing Waypoints

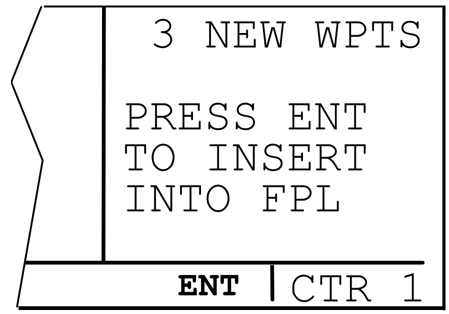


Figure 3D-108. CTR 1 Page - Center Waypoints

4. To view the Center waypoints before inserting them into the flight plan, turn the right inner knob to the CTR 2 page. Multiple Center 2 pages will be annunciated as CTR+2.

(a) The top line contains the identifier of the Center waypoint. The KLN 90B automatically creates the identifier by appending the first available two-digit number to the identifier of the nearest VOR to the waypoint. Therefore, if Plainview (PVW) is the nearest VOR to the first Center waypoint location, the 00 is appended to PVW to create PVW00. If PVW were later used in the creation of another Center waypoint, the second waypoint's identifier would be PVW01.

(b) The second line of the CTR 2 page shows the from Center followed by the to Center. In this example, PVW00 lies on the boundary between Ft. Worth (FW) and Albuquerque (ABQ) Centers.

(c) The third and fourth lines of the CTR 2 page display the Center waypoint location in terms of the identifier of the nearest VOR to the Center waypoint and the distance and radial from this VOR to the Center waypoint. Lines five and six display the Center waypoint location in terms of latitude and longitude. Refer to Figure 3D-109.

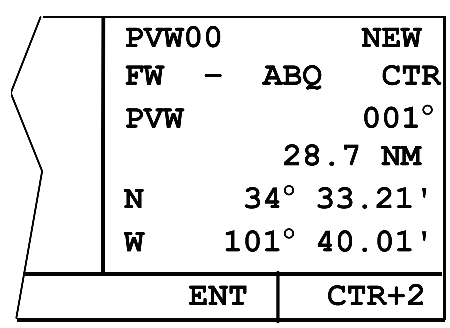


Figure 3D-109. Center 2 Page

(2) Inserting Center Waypoint Into Flight Plan. Insert the enter waypoints into the desired flight plan by returning to the CTR 1 page on the right side and pressing the **ENT** button. The Center waypoints are inserted into the flight plan in the correct order. Refer to Figure 3D-110.

```
USE? INVRT? |
  1:KLBB    |
  2:PVW00   | CTR WPT
  3:BGD00   | INSERTION
  4:GCK00   | COMPLETE
  5:KMCK    |
FPL 3| ENR - LEG    |CTR 1
```

Figure 3D-110. Insert Center Waypoints

(a) If inserting the waypoints would cause the number of waypoints to exceed 30, no Center waypoints are displayed and the CTR 1 page will display, NOT ENOUGH ROOM IN FPL.

(b) After the Center waypoints have been inserted into a flight plan, they may be viewed by returning to the CTR 2 page. As long as the same flight plan is displayed on the left side of the screen, the Center waypoints may be viewed by displaying the CTR 2 page(s). The CTR 1 and 2 pages return to their original format any time the specific flight plan is no longer displayed on the left side. To view the Center waypoints again, return to the specific flight plan, select the CTR 2 page, and press the **ENT** button.

(c) Center waypoints are stored as part of the 250 user-defined waypoints and are considered supplemental waypoints. When Center waypoints are viewed on the SUP page or on the active waypoint (ACT) page, they appear in the normal supplemental waypoint format. Center waypoints that are part of a flight plan show up on the OTH 3 page. Center waypoints that are no longer part of a flight plan are deleted from the list of user-defined waypoints when the KLN 90B is turned off.

(d) Once center waypoints have been inserted into a flight plan, they are treated like any other waypoints in the flight plan. If a flight plan containing center waypoints is modified in any way, new center waypoints may be computed. The original center waypoints are now part of the flight plan and new center waypoints are computed by treating the original center waypoints the same as any other waypoints in the flight plan. If the interior of a flight plan containing center waypoints is modified, it may be desirable to manually delete obsolete center waypoints from the flight plan before computing new ones; however, if the flight plan is modified by adding new waypoints to the end of the flight plan, this may not be necessary.

3D-4. THE STATUS PAGES.

There are four status pages. The STA 1 and STA 2 pages display information pertaining specifically to the GPS receiver, while the STA 3 and STA 4 pages display supplementary information pertaining to the KLN 90B.

The STA 1 and STA 2 pages may be viewed at any time to determine the status of the GPS receiver and the GPS satellites being received. This includes which satellites are being tracked, the satellites health, the signal to noise ratio for each of the satellites, the elevation of each satellite above the horizon, and the estimated position error.

The GPS receiver in the KLN 90B is capable of using signals from up to eight satellites to determine position. A valid position may be determined using as few as four satellites alone or three satellites with an altitude input. However, four satellites alone or three satellites with an altitude input do not necessarily ensure that navigation can take place. The satellites must be positioned relative to the aircraft such that sufficient geometry exists to determine an accurate position. The satellite constellation geometry is continually changing as each satellite rises, travels across the sky, and eventually sets relative to the aircraft's position. The GPS satellites are not in geosynchronous orbits positioned over the same spot on the earth at all times. Rather, the GPS satellites are in orbits that allow them to circle the earth about two times each day.

a. STA 1 Page. There will be two STA 1 pages if more than four satellites are being received. The GPS state is indicated on line 1. Refer to Table 3D-17 for GPS status codes and their meanings.

Table 3D-17. GPS Status Codes

DISPLAY	EXPLANATION
ACQ	Acquisition
DEGRD	Navigation with position degradation
FAILR	Receiver failure
INIT	Initialization
NAV	Navigation
NAV A	Navigation with altitude aiding
NAV D	Navigation with data collection

TRAN	Transition

(1) In the initialization state, the GPS receiver is in the process of initializing itself and collecting information such as the date, time, and last position. Next the receiver collects data from its own memory to determine which satellites should be visible. After completing the initialization process, the receiver begins the acquisition process. During this time, the visible satellites are being acquired and data from them is being obtained.

(2) The transition state indicates an adequate number of satellites for navigation has been acquired and is being tracked but no position data can yet be produced.

(3) Normal navigation is indicated by a Nav, NAV A, or a NAV D GPS state. NAV A indicates that the altitude input is being used in the position solution. NAV D indicates that besides calculating position, the receiver is collecting and storing in its memory ephemera and almanac data information.

(4) The specific GPS satellites or Space Vehicles (SV), being received are displayed in the left column. Each satellite has its own identification number. An * to the left of the satellite number indicates this particular satellite is not presently being used in the navigation solution.

(5) The satellite's health is indicated to the right of the satellite number. The health information is transmitted by the satellite. Health designators are defined in Table 3D-18.

(6) The Signal to Noise Ratio (SNR) for each satellite being received is displayed in the middle column and indicated the signal strength for each satellite. The higher the SNR value the stronger the signal. Values usable for navigation will be in the mid 30's to mid 50's. Typical values are in the middle of this range.

Table 3D-18. Satellite Health

DISPLAY	EXPLANATION
B	Bad
W	Weak
–	Unknown
Blank	Good

(7) The elevation (ELE) above the horizon for each satellite is provided in the right column and will range from 5º to 90º. Refer to Figure 3D-111.

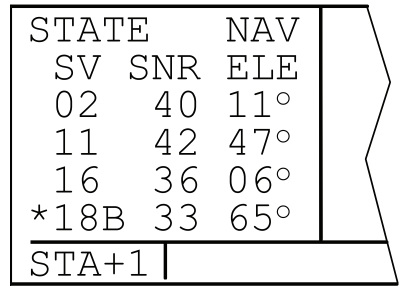


Figure 3D-111. STA 1 Page

b. STA 2 Page. The STA 2 page displays the systems estimate of the position error expressed in nautical miles. Refer to Figure 3D-112. The KLN 90B's position error depends on such factors as the number of satellites being received, the strength of the GPS signals, and the geometry of the satellites presently being used for navigation.

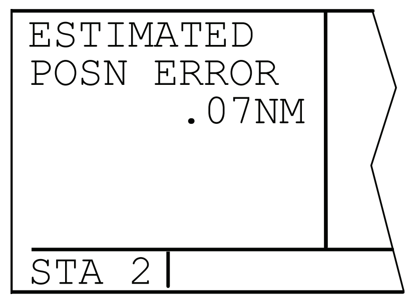


Figure 3D-112. STA 2 Page

c. STA 3 Page. The STA 3 page displays the software revision status of the KLN 90B host computer and of the GPS receiver. A field called OBS CAL is also included on this page. The value indicates the calibration of the internal resolver circuitry of the KLN 90B.

d. STA 4 Page. The STA 4 page displays the KLN 90B's total operating time and also the number of times the unit has been turned on. These values are set to zero if the KLN 90B's nonvolatile memory is cleared.

3D-5. MESSAGES.

a. Message Page. The following is a list of messages that can appear on the message page.

(1) ACTV ANNUNCIATOR FAIL - This message appears when there is a failure of the KLN

90B ACTV annunciator drive circuitry. To determine if the approach mode is active, look at the status line of the KLN 90B.

(2) *ADJ NAV IND CRS TO 123°* - The pilot should select the suggested course on the EHSI. This message occurs at the beginning of turn anticipation. It also appears when the difference between the EHSI's selected course and the desired track (DTK) is greater than 0.5°.

(3) *ADJ NAV IND CRS* - This message may appear in installations where the KLN 90B is interfaced with EFIS or with a mechanical EHSI through the KA 90 adapter. Appears when the difference between the EHSI's selected course and the KLN 90B's selected course is greater than 0.5°.

(4) *AIRSPACE ALERT* - This message indicates estimated time to enter special use airspace is approximately 10 minutes or the distance is less than 2 nautical miles.

(5) *ALTITUDE FAIL* - This message indicates that the altitude input failed. Altitude related features will be disabled.

(6) *APT ELEVATION UNKNOWN* - This message indicates that airport elevation for height above airport alert unknown.

(7) *ARINC 429 AIR DATA FAIL* - This message indicates that the air data systems with ARINC 429 outputs are not being received correctly by the KLN 90B.

(8) *ARINC 429 OUTPUT FAIL* - This message indicates that the KLN 90B ARINC 429 output fails test. This affects EHI 40/50 electronic EHSI and some navigation graphics displays.

(9) *ARM ANNUNCIATOR FAIL* - This message displays when there is a failure of the KLN 90B ARM annunciator drive circuitry. To determine if the approach mode is armed, look at the status line of the KLN 90B.

(10) *ARM GPS APPROACH* – If the approach arm mode has been disarmed, the KLN 90B will prompt arming the approach mode when the aircraft is three nautical miles from the FAF.

(11) *BAD SATELLITE GEOMETRY AND RAIM NOT AVAILABLE* – Appears only if in the approach active mode, RAIM is not available, and the satellite geometry has further degraded to cause more uncertainty of the aircraft position.

(12) *BAD SATELLITE GEOMETRY SEE EPE ON STA 2 PAGE* – RAIM is not available. Possible position error is greater than allowed for IFR flight. Crosscheck the position of the aircraft with other means of navigation.

(13) *BATTERY LOW: SERVICE REQUIRED TO PREVENT LOSS OF USER DATA* – Internal battery is low and needs replacement.

(14) *CHECK ACTV ANNUNCIATOR* – A failure between the KLN 90B and the annunciator. To determine if the approach -mode is active, look at the status line of the KLN 90B.

(15) *CHECK ARM ANNUNCIATOR* – A failure between the KLN 90B and the annunciator. To determine if the approach mode is armed, look at the status line of the KLN 90B.

(16) *CHECK MSG ANNUNCIATOR* – A failure between the KLN 90B and the annunciator. To determine if message alerting is being given, check the display of the KLN 90B.

(17) *CHECK WPT ANNUNCIATOR* – A failure between the KLN 90B and the annunciator. To determine if waypoint alerting is being given, check the display of the KLN 90B.

(18) *DATABASE CHECKSUM ERR* – Database fails internal test. Most likely cause is a failed database cartridge.

(19) *DATABASE OUT OF DATE ALL DATA MUST BE CONFIRMED BEFORE USE* – Database is out of date.

(20) *EEPROM FAILURE: 1C ___ EXTERNAL D-BAR INVALID* – The blanks contain the designator of a specific failed component. Record the data. Do not use it and external EHSI. The rest of the KLN 90B is still usable including the internal CDI. The page displays may not be centered on the screen.

(21) *IF REQUIRED SELECT OBS* – The aircraft is 4 nm from a waypoint which could be used as the basis of either a procedure turn or a holding pattern.

(22) *INSIDE SPC USE AIRSPACE* – Aircraft's present position is inside an area of special use airspace.

(23) *MAGNETIC VAR INVALID ALL DATA REFERENCED TO TRUE NORTH* – Magnetic variation is invalid due to operation outside of the

database magnetic variation area without having a pilot entered magnetic variation.

(24)MSG ANNUNCIATOR FAIL – This message displays when there is a failure of the KLN 90B MSG annunciator drive circuitry. To determine if message alerting is being given, check the display of the KLN 90B.

(25)NAV SUPER FLAG FAILURE – An internal test fails for a specific NAV flag output. The KLN 90B is still usable. EHSI and autopilot should be used with caution.

(26)NO RCVR DATA – The GPS receiver fails a specific internal test. The unit will not provide any navigation capability.

(27)NO RS-232 DATA – Appears when no input is received on the RS-232 input, such as a fuel management or air data system.

(28)OBS WPT > 200 NM – The KLN 90B is in the OBS mode and the distance to the active waypoint is more than 200 nm. The system will perform normally, however, at this distance the deviation bar will be extremely sensitive to changes in selected course.

(29)OTHER WAYPOINTS DELETED – Appears when the message WAYPOINT ___ DELETED would be effective for more than 10 waypoints.

(30)POSITION DIFFERS FROM LAST POSITION BY > 2 NM – Appears when the GPS sensor first reaches the NAV mode, if the new position differs from the position when the power was turned off by more than 2 nautical miles.

(31)POSITION OF WPT HAS CHANGED – Either the latitude or the longitude of a waypoint used in a flight plan or the active waypoint has changed by more than 0.33 minutes as a result of updating the database.

(32)POSITIONS OF OTHER WAYPOINTS HAVE CHANGED – Appears when the above message, POSITION OF WPT HAS CHANGED would be effective for more than 10 waypoints.

(33)PRESS ALT TO SET BARO – Appears when the approach mode is armed.

(34)PRESS GPS APR FOR NAV – Appears after the NAV flag has displayed due to a RAIM problem while the unit is in the approach mode. By pressing the **GPS APR** button, the unit will be able to restore navigation information so that a missed approach may be conducted based on navigation information provided by the KLN 90B.

(35)RAIM NOT AVAILABLE APR MODE INHIBITED PREDICT RAIM ON STA 5 – Appears when integrity monitoring (RAIM) is predicted to not be available at either the FAF or the MAP. The KLN 90B will not allow the unit to go into the approach active mode. Turn to STA 5 page to perform a RAIM prediction.

(36)RAIM POSITION ERROR CROSS CHECK POSITION – The unit has detected a problem with one of the satellites and the position cannot be assured to be within IFR limits. Cross check the position of the aircraft with other means of navigation every 15 minutes to verify the position.

(37)RCVR HARDWARE ERROR:______ – Appears when the unit fails a specific internal test. Record the numerical value.

(38)RECYCLE POWER TO USE CORRECT DATABASE DATA – The date entered on the self test page is before the database effective date and the date entered on the SET 2 page is after the database effective date, or vice versa. Turn the unit off and back on.

(39)REDUNDANT WPTS IN FPL EDIT EN ROUTE WPTS AS NECESSARY – Appears after the pilot inserts an approach or SID/STAR procedure in the flight plan. Remove those waypoints that occur both in the en route and the SID/STAR sections.

(40)RS-232 DATA ERROR – An error is detected in the received RS-232 data such as from a fuel management or air data system.

(41)RS-232 OUTPUT ERROR – RS-232 output fails internal test. Do not use moving map displays.

(42)SATELLITE COVERAGE INADEQUATE FOR NAV – Received GPS signals are not adequate for navigation. Insufficient number of satellites or inadequate satellite geometry to accurately determine the position within 3.8 nm.

(43)SET FUEL ON BOARD ON OTH 5 IF NECESSARY – Appears when the KLN 90B is interfaced with a fuel flow computer that allows the fuel on board to be set.

(44)SYSTEM TIME UPDATED TO GPS TIME – Appears when the KLN 90B system time is

automatically updated to GPS time by more than 10 minutes.

(45) USER DATA LOST – Appears when the unit determines that the internal memory backup battery is dead or that some other internal failure has occurred which has caused all user entered data to be lost.

(46) VNV ALERT – Appears when a VNAV operation has been programmed on the NAV 4 page and the estimated time to start the climb or descent is approximately 90 seconds.

(47) WAYPOINT ___ DELETED – Appears when a waypoint used in a flight plan, or the active waypoint, no longer exists as a result of updating the database. The waypoint is deleted from flight plans in which it was used.

(48) WPT ANNUNCIATOR FAIL – This message displays when there is a failure of the KLN 90B WPT annunciator drive circuitry. To determine if waypoint alerting is being given check the display of the KLN 90B.

b. Status Line Messages. These are short, operational messages that are displayed in the lower center segment of the screen.

(1) ACTIVE WPT – Appears if an attempt is made to delete a waypoint on the OTH 3 page and the waypoint is the active waypoint.

(2) D CRS XXX° – Appears when the KLN 90B is in the OBS mode and is interfaced with an external indicator which the KLN 90B cannot change the selected course and the pilot performs a direct to operation. Since the KLN 90B cannot change the selected course, the pilot is given a message for the OBS value to set the indicator to.

(3) DUP IDENT – More than one waypoint of that type has the same identifier.

(4) ENT LAT / LON – A reminder to enter the location of a user-defined waypoint.

(5) FPL FULL – An attempt has been made to add a waypoint to a flight plan that already contains 30 waypoints.

(6) IN ACT LIST – Appears when a user-defined VOR is the active waypoint and attempt is made to change the stored magnetic variation of this VOR. The magnetic variation cannot be changed while the VOR is the active waypoint.

(7) INVALID ADD – Appears when an attempt is made to add a waypoint to an approach.

(8) INVALID DEL – Appears when an attempt is made to delete a waypoint from an approach.

(9) INVALID ENT – Appears when an attempt is made to enter invalid data, e.g., 30 FEB 96.

(10) INVALID REF – Appears with an attempt to create an invalid reference waypoint.

(11) INVALID VNV – Appears when a waypoint identifier has been entered on the NAV 4 page if the waypoint is not valid for VNAV operation.

(12) NO ACTV WPT – Appears with an attempt to activate the OBS mode if there is no active waypoint.

(13) NO APPROACH – Appears with an attempt to arm the GPS approach mode when there is no approach loaded into the active flight plan.

(14) NO APT WPTS – Appears when the APT type pages have been selected if the KLN 90B doesn't contain a database cartridge and there are no user-defined airport waypoints.

(15) NO INT WPTS – Appears when the INT type pages have been selected if the KLN 90B doesn't contain a database cartridge and there are no user-defined intersection waypoints.

(16) NO INTRCEPT – Appears when an attempt is made to recalculate the intercept point on a DME arc and the actual track does not intercept the arc.

(17) NO NDB WPTS – Appears when the NDB type pages have been selected if the KLN 90B doesn't contain a database cartridge and there are no user-defined NDB waypoints.

(18) NO SUCH WPT – Appears when there is no waypoint in the database corresponding to the identifier entered on the reference waypoint page.

(19)NO SUP WAPTS – Appears when the SUP type pages have been selected if the KLN 90B doesn't contain a database cartridge and there are no user-defined supplemental waypoints.

(20)NO VOR WPTS – Appears when the VOR type pages have been selected if the KLN 90B doesn't contain a database cartridge and there are no user-defined VOR waypoints.

(21)OUTDATED DB – Appears whenever the pilot attempts to select an approach from an outdated database.

(22)RMKS FULL – Appears when an attempt is made to create a user entered airport remark on the APT 5 page if 100 user entered airport remarks already exist.

(23)RWY MISSING – Appears when the APT 3 page runway diagram shows some, but not all, of the runways at the selected airport.

(24)USED IN FPL – Appears when an attempt is made to delete a user-defined waypoint on the OTH 3 page if the waypoint is used in a flight plan.

(25)USR DB FULL – Appears with an attempt to create a user-defined waypoint if the user database already contains 250 waypoints.

3D-6. ABBREVIATIONS.

For a complete list of abbreviations, see Allied Signal's Pilot's Guide for the KLN 90B Navigation System.

CHAPTER 4
MISSION EQUIPMENT

4-1. MISSION EQUIPMENT.

Mission equipment is not installed on this aircraft.

CHAPTER 5
OPERATING LIMITS AND RESTRICTIONS

Section I. GENERAL

5-1. PURPOSE.

This chapter identifies or refers to operating limits and restrictions that shall be observed during ground and flight operations.

5-2. GENERAL.

The operating limitations set forth in this chapter are the direct result of design analysis, tests, and operating experiences. Compliance with these limits will allow the pilot to safely perform the assigned missions and to derive maximum utility from the aircraft. Limits concerning maneuvers, weight, and center of gravity are also covered in this chapter.

5-3. EXCEEDING OPERATIONAL UNITS.

Anytime an operational limit is exceeded, an appropriate entry shall be made on DA Form 2408-13-1. Entry shall state the limit or limits that were exceeded, range, time beyond limits, and any additional data that would aid maintenance personnel in the maintenance action that may be required.

5-4. MINIMUM CREW REQUIREMENTS.

The minimum crew required for aircraft flight operations is two pilots.

Section II. SYSTEM LIMITS

5-5. INSTRUMENT MARKINGS.

Figure 5-1, Sheets 1 through 8, illustrates the instruments' operating limitations. The operating limitations are color coded on the instrument faces. Color coding of each instrument is explained in the illustration.

5-6. INSTRUMENT MARKING COLOR CODES.

The colored markings that appear on the dial faces of engine, flight, and utility system instruments indicate operating limitations and ranges. Red markings indicate the limit above or below which continued operation is likely to cause damage or shorten life. The green markings indicate the safe or normal range of operation. The yellow markings indicate the range when special attention should be given to the operation covered by the instrument. Operation is permissible in the yellow range, but should be avoided. White markings on the airspeed indicator denote the flap operating range. The blue marking on the airspeed indicator denotes best rate of climb with one engine inoperative, at 12,500 lbs., maximum forward center of gravity, sea level standard day conditions.

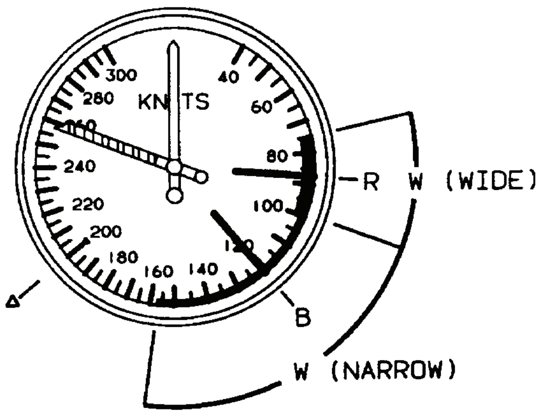
5-7. PROPELLER LIMITATIONS.

R The maximum propeller overspeed limit is 2200 RPM and is time-limited to 5 seconds. Sustained propeller overspeeds faster than 2000 RPM indicate failure of the primary governor. Flight may be continued at propeller overspeeds up to 2120 RPM, provided torque is limited to 81%. Sustained propeller overspeeds faster than 2120 RPM indicate failure of both the primary governor and the overspeed governor.

T3 **F3** The maximum propeller overspeed limit is 2200 RPM and is time-limited to 5 seconds. Sustained propeller overspeeds faster than 2000 RPM indicate failure of the primary governor. Flight may be continued at propeller overspeeds up to 2120 RPM, provided torque is limited to 1800 ft-lb. Sustained propeller overspeeds faster than 2120 RPM indicate failure of both the primary governor and the overspeed governor. Propeller RPM is limited to 1150 RPM for continuous unfeathered ground operations.

CAUTION

Propellers may be feathered on the ground and idled at rotational speeds less than 600 RPM, however propeller blade erosion may result.



AIRSPEED

R/W — 259 KIAS MAXIMUM V_{mo} (0.52 MACH)

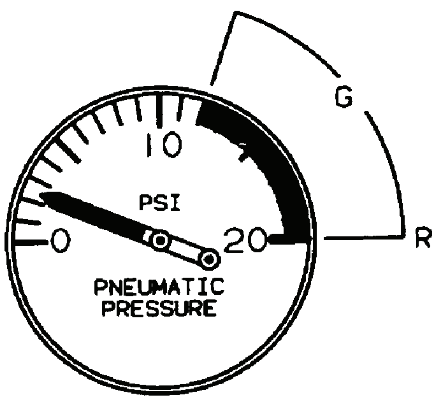
NOTE
MAXIMUM ALLOWABLE AIRSPEED (RED STRIPED) POINTER IS SELF ADJUSTING WITH ALTITUDE

R — 86 KIAS MINIMUM SINGLE-ENGINE CONTROL SPEED (V_{mca})

B — 121 KIAS ONE-ENGINE INOPERATIVE BEST RATE-OF-CLIMB (V_{yse})

W — 75-157 KIAS FULL FLAP OPERATING RANGE (WIDE WHITE ARC 75-99, NARROW WHITE ARC 99-157)

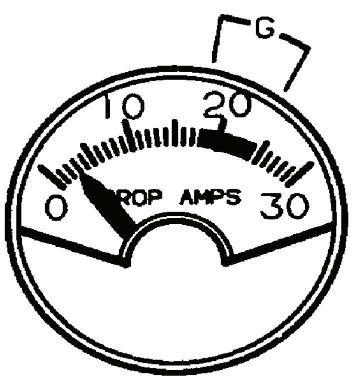
W △ — 200 KIAS MAXIMUM APPROACH FLAP EXTENSION SPEED



PNEUMATIC PRESSURE

G — 12-20 PSI NORMAL OPERATING RANGE

R — 20 PSI MAXIMUM

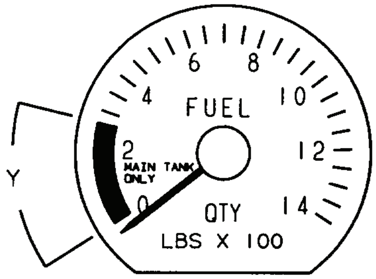


PROPELLER DEICER AMMETER

G — 18-24 AMPERES NORMAL OPERATION

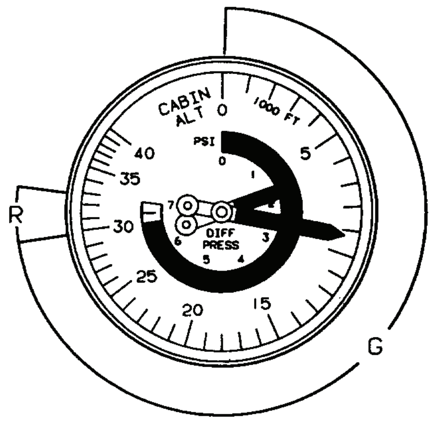
COLOR CODES	
R = RED	B = BLUE
G = GREEN	W = WHITE
Y = YELLOW	BK = BLACK

Figure 5-1. Instrument Markings R T3 F3 *(Sheet 1 of 8)*



FUEL QUANTITY

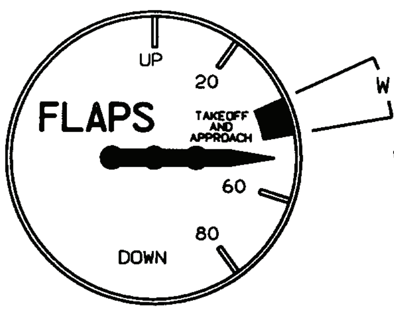
Y ■ 0-265 LBS NO TAKEOFF RANGE



CABIN ALTIMETER AND DIFFERENTIAL PRESSURE

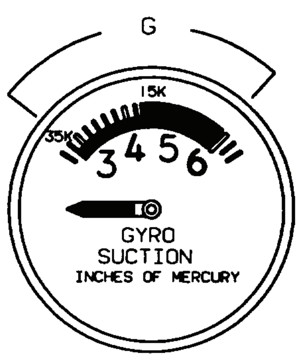
G ■ 0-6.6 PSI NORMAL RANGE

R ■ 6.6 PSI MAXIMUM



FLAP POSITION INDICATOR

W ■ 40% TAKEOFF AND APPROACH



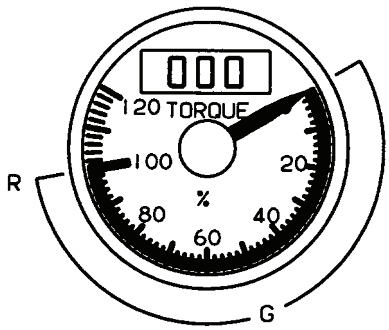
GYRO SUCTION

G ■ 2.8 TO 4.3 IN. HG, NARROW GREEN ARC (NORMAL FROM 35,000 TO 15,000 FEET)

4.3 TO 5.9 IN. HG, WIDE GREEN ARC (NORMAL FROM 15,000 TO SEA LEVEL)

35K MARKED ON FACE OF GAGE AT 3.0 IN. HG
15K MARKED ON FACE OF GAGE AT 4.3 IN. HG

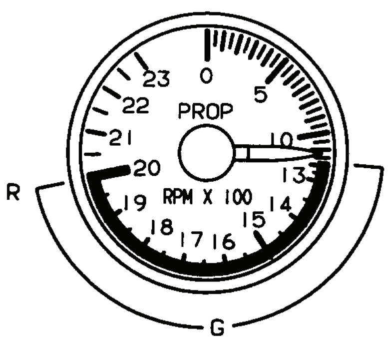
Figure 5-1. Instrument Markings R T3 F3 (Sheet 2 of 8)



TORQUE

G — 0 - 100% NORMAL OPERATING RANGE

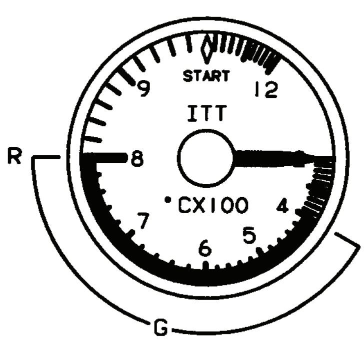
R — 100% MAXIMUM



PROPELLER TACHOMETER

G — 1180 - 2000 RPM NORMAL OPERATING RANGE

R — 2000 RPM MAXIMUM



INTERSTAGE TURBINE TEMPERATURE

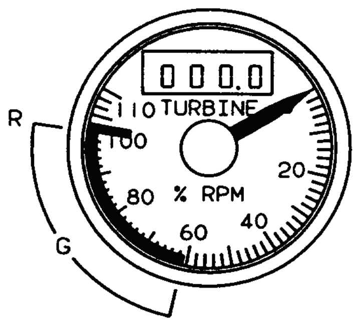
G — 400 - 800°C NORMAL OPERATING RANGE

R — 800°C MAXIMUM TAKEOFF

R ♦ — 1000°C MAXIMUM STARTING

*Figure 5-1. Instrument Markings **R** (Sheet 3 of 8)*

TURBINE TACHOMETER (N_1 SPEED)



G 61 - 101.5% NORMAL OPERATING RANGE

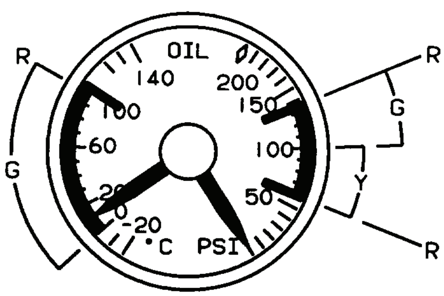
R 101.5% MAXIMUM

OIL TEMPERATURE AND PRESSURE

OIL TEMPERATURE SCALE

G 0 - 99°C NORMAL OPERATING RANGE

R 99°C MAXIMUM



OIL PRESSURE SCALE

R 60 PSI MIMIMUM
135 PSI MAXIMUM

Y 60 - 100 PSI

G 100 - 135 PSI NORMAL OPERATING RANGE

R ♦ 200 PSI MAXIMUM STARTING WITH COLD OIL

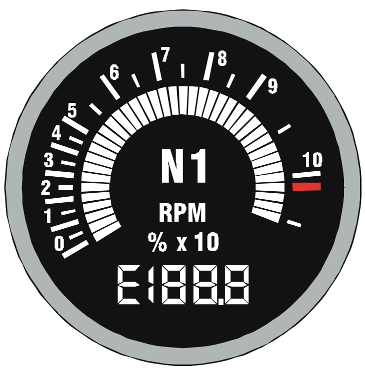
NOTE: ± 10 PSI FLUCTUATIONS ARE ACCEPTABLE

Figure 5-1. Instrument Markings **R** *(Sheet 4 of 8)*

TORQUE
1100 FT-LB MAXIMUM BELOW 1600 RPM

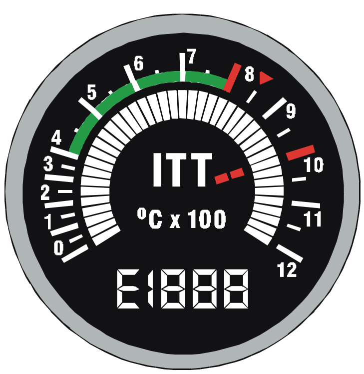
G — 600 TO 2230 FT LB NORMAL OPERATING RANGE

R — 2230 FT LB MAXIMUM



TURBINE TACHOMETER (N_1 SPEED)

R — 101.5% MAXIMUM



INTERSTAGE TURBINE TEMPERATURE INDICATOR

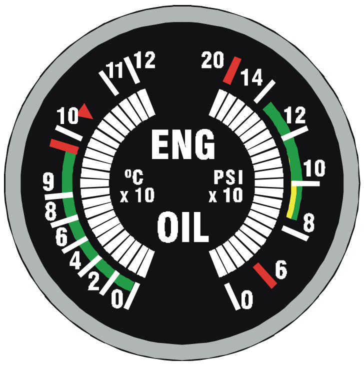
G — 400-800 °C NORMAL OPERATING RANGE

R — 800 °C MAXIMUM CONTINUOUS

R — 1000 °C MAXIMUM STARTING (5 SECONDS)

R — TRANSIENT ACCELERATION RANGE
850 °C MAXIMUM TRANSIENT

Figure 5-1. Instrument Markings T3 (Sheet 5 of 8)



OIL TEMPERATURE AND PRESSURE INDICATOR

OIL TEMPERATURE SCALE

G — 0-99°C NORMAL OPERATING RANGE

R — 99°C MAXIMUM

R ▲ — 104°C TRANSIENT (5 MINUTES)

OIL PRESSURE SCALE

R — 60 PSI MINIMUM

G — 85-100 PSI NORMAL RANGE ABOVE 21,000 FEET
Y — 85-100 PSI CAUTION RANGE BELOW 21,000 FEET

G — 100-135 PSI NORMAL OPERATING BELOW 21,000 FEET

R — 200 PSI MAXIMUM STARTING WITH COLD OIL

PROPELLER TACHOMETER

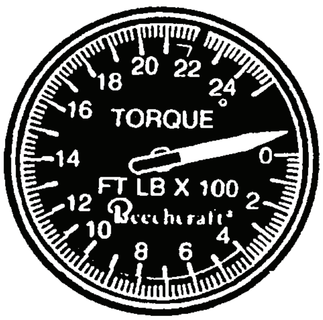
G — 1600-2000 RPM NORMAL OPERATING RANGE

R — 2000 RPM MAXIMUM

Figure 5-1. Instrument Markings **T3** *(Sheet 6 of 8)*

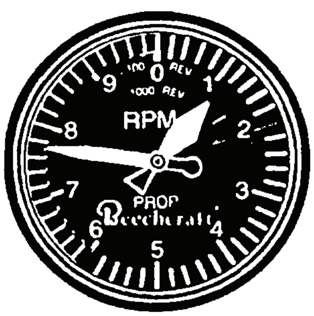
INTERSTAGE TURBINE TEMPERATURE

G		400-800°C NORMAL OPERATING RANGE
R		800°C MAXIMUM CONTINUOUS
R W		1000°C MAXIMUM (STARTING)



TORQUE

G		400-2230 FT. LB. NORMAL OPERATING RANGE
R		2230 FT. LB. MAXIMUM AT 2000 RPM



PROPELLER TACHOMETER

G		1600-2000 RPM NORMAL OPERATING RANGE
R		2000 RPM MAXIMUM

TURBINE TACHOMETER (N1 SPEED)

R		101.5% MAXIMUM

Figure 5-1. Instrument Markings **F3** *(Sheet 7 of 8)*

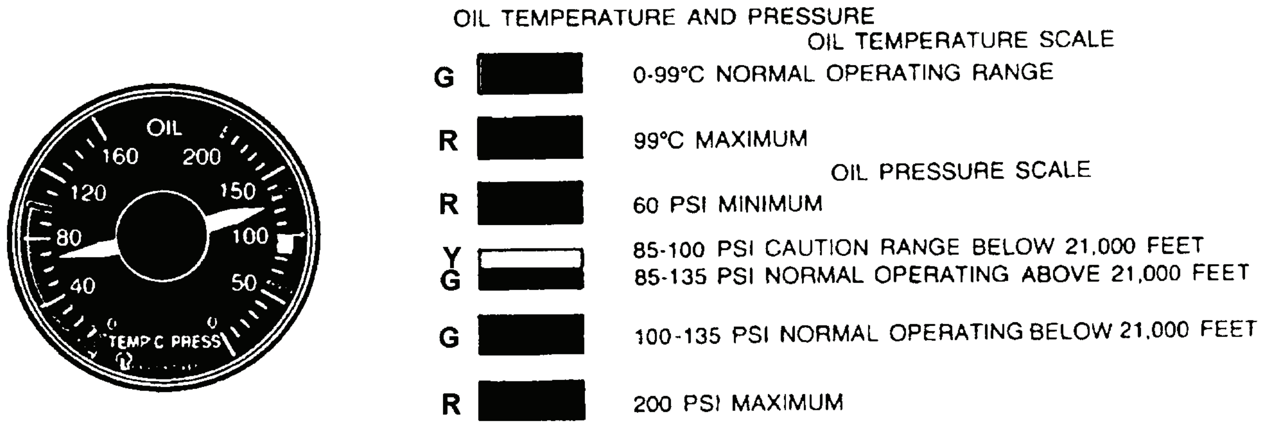


Figure 5-1. Instrument Markings **F3** *(Sheet 8 of 8)*

5-8. STARTER LIMITATIONS.

Use of the starter is limited to 40 seconds on, 60 seconds off, 40 seconds on, 60 seconds off, 40 seconds on, then 30 minutes off. Contact maintenance personnel for assistance if no engine start occurs during this cycle.

5-9. AUTOPILOT LIMITATIONS.

a. During autopilot operations, a pilot must be seated at the controls with seat belt fastened.

b. Maximum speed limit for autopilot operation is unchanged from the aircraft maximum-speed limit.

c. Autopilot operation is prohibited below 200 feet above ground level. This includes takeoffs and landings.

d. The minimum approach speed for coupled approaches is 120 KIAS.

e. Autopilot operation is prohibited in severe icing conditions.

f. The autopilot preflight check must be satisfactorily completed prior to the first takeoff of the day or the **AP/TRIM POWER (R)/AP ENGAGE (F3/T3)** switch must be set to the **OFF** position.

g. For proper operation in **VOR NAV** or **VOR APR** modes, the DME and NAV receivers must be channeled to the same source. Ensure DME HOLD has not been selected.

5-10. FUEL SYSTEM LIMITS.

NOTE

Aviation gasoline (AVGAS) contains a form of lead that has an accumulative adverse effect on gas turbine engines. The lowest octane AVGAS available (less lead content) should be used. If any AVGAS is used, the total operating time must be entered on DA Form 2408-13-1. Operating time on AVGAS is computed based on quantity used and average consumption.

a. Operating Limits.

(1) Operation with **FUEL PRESS** annunciator light illuminated is limited to 10 hours. Log time (duration) **FUEL PRESS** light is illuminated on DA Form 2408-13-1.

(2) Crossfeed of AVGAS to an engine with a failed engine-driven boost pump is not authorized. Such a crossfeed will result in less than minimum fuel pressure to the high-pressure pump on that side.

(3) Takeoff torque may not be attainable during operations with AVGAS.

(4) AVGAS operation is limited to 150 hours.

(5) Crossfeed fuel will not be available from the side with an inoperative standby boost pump.

(6) The use of AVGAS requires the standby boost pumps to be used during all operations above 15,000 feet.

(7) Operation with JP-4 requires the use of standby pumps above 30,000 feet.

b. Fuel Management. Auxiliary tanks will not be filled for flight unless the main tanks are full. Maximum allowable fuel imbalance is 1000 pounds. Do not take off if fuel quantity gauges indicate in yellow arc (less than 265 pounds of fuel in each main tank). Normally, crossfeed only during single engine operation or while maintaining fuel balance within limits.

CAUTION

Anti-icing additive must be properly blended with the fuel to avoid deterioration of the fuel cell. The additive concentration by volume shall be a minimum of 0.060% and a maximum of 0.15%.

Some fuel suppliers blend in anti-icing additive in their storage tanks. Prior to refueling, check with the fuel supplier to determine if fuel has been blended. To assure proper concentration by volume of fuel on board, blend only enough additive for the unblended fuel.

c. Fuel System Anti-Icing. Icing inhibitor conforming to MIL-L-27686 will be added to commercial fuel not containing an icing inhibitor during fueling operations, regardless of ambient temperatures. The additive provides anti-icing protection and functions as a biocide to kill microbiological growth in the aircraft fuel system.

d. Limitations with Ferry Fuel Tanks Installed.

WARNING

Failure to comply with Paragraph 5-10.d.(1) could result in the collapse of the tanks. If the 1500 feet per minute rate of descent is exceeded the air may not flow through the surge tank and tank vent lines fast enough to keep the tank air pressure and cabin air pressure equalized. If an extreme emergency dictates a greater rate of descent, then loosening or removing the tank caps will allow the two air pressures to equalize but could allow fuel fumes to escape into the cabin.

(1) The cabin air pressure **RATE OF DESCENT MUST NOT EXCEED 1500 FEET PER MINUTE** when the extended range fuel tanks are installed in the cabin and the caps are on.

(2) Maximum quantity of fuel carried in the ferry fuel tanks must not exceed 240 U.S. gallons total.

(3) Aerobatics are prohibited.

(4) Weather conditions with moderate to severe turbulence will be avoided.

(5) When an over 12,500 pound landing has been made or the aircraft has encountered moderate to severe turbulence while over 12,500 pounds, the aircraft must be inspected for damage. Inspections performed and the findings must be entered in the Airframe Log Book. The pilot in command is responsible, ***before*** the next flight, to determine that the aircraft is in an airworthy condition.

(6) The use of autopilot during operations over 12,500 pounds is prohibited.

5-11. LANDING GEAR CYCLING AND BRAKE DEICE LIMITATIONS.

a. Hydraulic Landing Gear. Landing gear cycles, a complete retraction and extension, are limited to one every 5 minutes for a total of six cycles followed by a 15 minute cool-down period.

b. Brake Deice. The following limitations apply to the brake deice system:

(1) The brake deice system shall not be operated at ambient temperatures above 15 °C.

(2) The brake deice system shall not be operated longer than 10 minutes, one timer cycle, with the landing gear retracted. If operation does not automatically terminate approximately 10 minutes after gear retraction, turn **BRAKE DEICE** switch **OFF.**

(3) Maintain 85% N_1 or higher during simultaneous operation of the brake deice and surface deice systems. If adequate pneumatic pressure cannot be provided for simultaneous operation of the brake deice and surface deice systems, turn **BRAKE DEICE** switch **OFF.**

(4) **BRAKE DEICE** switch shall be turned **OFF** during single engine operation, in order to maintain an adequate supply of systems pneumatic bleed air.

5-12. PITOT HEAT LIMITATIONS.

Pitot heat should not be used for more than 15 minutes while the aircraft is on the ground.

Section III. POWER LIMITS

5-13. ENGINE LIMITATIONS.

Observe limitations found in Tables 5-1 and 5-2 during operation of this aircraft.

Each column is a separate limitation. The limits presented do not necessarily occur simultaneously. Whenever operating limits are exceeded, record the value and duration of the condition encountered in the aircraft log. Instruments, with reference to the operating limits marked on the face of each instrument, monitor operation of the engines.

CAUTION

Engine operation using only the engine-driven fuel pump without boost pump fuel pressure is limited to 10 cumulative hours. All time in this category shall be entered on DA Form 2408-13-1 for the attention of maintenance personnel.

NOTE

Use of aviation gasoline is time-limited to 150 hours of operation during any Time-Between-Overhaul period. It may be used in any quantity with primary or alternate fuel.

5-14. OVERTEMPERATURE AND OVERSPEED LIMITATIONS.

a. Whenever limiting temperatures, listed in Tables 5-1 and 5-2, are exceeded and cannot be controlled by retarding the power levers, shutdown the engine and land as soon as possible.

b. During engine starting, the temperatures and time limits, listed in Tables 5-1 and 5-2, must be observed. When these limits are exceeded, the incident will be entered as an engine discrepancy in the appropriate maintenance forms. It is particularly important to record the amount and duration of overtemperature.

c. Whenever the prescribed engine overspeed limit or engine RPM operating limit is exceeded, the incident must be reported as an engine discrepancy in the appropriate maintenance forms. It is particularly important to record the maximum percent of RPM registered by the tachometer, and the duration of overspeed.

d. Continued engine operation above 770 °C will reduce engine life.

5-15. POWER DEFINITIONS FOR ENGINE OPERATIONS.

The following definitions describe the engine power ratings.

a. Takeoff Power. The maximum power permissible for a takeoff.

b. Maximum Continuous Power. The maximum continuous power is the highest power rating not limited by time. Use of this rating is intended for emergencies at the discretion of the pilot.

5-16. GENERATOR LIMITS.

Maximum generator load is limited for flight and variable during ground operations. Observe the limits shown in Table 5-3 during ground operation. For flight operations, 100% may be used to FL310 and limited to 88% above FL310. Voltage limits are 27.5 to 29 volts DC.

Table 5-1. Engine Operating Limitations **R**

OPERATING CONDITION	SHP	TORQUE % (1)	MAXIMUM OBSERVED ITT ºC	GAS GENERATOR RPM N_1		PROP RPM N_2	OIL PRESS PSI (2)	OIL TEMP ºC (3) (4)
				RPM	%			
STARTING	– – –	– – –	1000 (5)	– – –	– – –	– – –	– – –	-40 (min)
LOW IDLE	– – –	– – –	750 (6)	22,875	61(min)	1180	60 (min)	-40 to 99
HIGH IDLE	– – –	– – –	– – –	– – –	(7)	– – –	– – –	-40 to 99
TAKEOFF and MAX CONT	850	100	800	38,100	101.5	2000	100 to 135	0 to 99
MAX CRUISE	850	100 (8)	800	38,100	101.5	2000	100 to 135	0 to 99
CRUISE CLIMB and REC (NORMAL) CRUISE	850	100 (8)	770	38,100	101.5	2000	100 to 135	0 to 99
MAX REVERSE (9)	800	– – –	750	– – –	88	1900	100 to 135	0 to 99
TRANSIENT	– – –	123 (5)	850	38,500 (10)	102.6 (10)	2200 (5)	200	0 to 104 (11)

TABLE NOTES:

(1) Torque limit applies within range of 1600 - 2000 propeller RPM (N_2). Below 1600 propeller RPM, torque is limited to 49%.

(2) When gas generator speeds are above 27,000 RPM (72% N_1) and oil temperatures are between 60 °C and 71°C, normal oil pressures are: 100 to 135 psi below 21,000 feet; and 85 to 135 psi at 21,000 feet and above.

During extremely cold starts, oil pressure may reach 200 psi. Oil pressure between 60 and 85 psi is undesirable. It should be tolerated only for the completion of the flight, and then only at a reduced power setting not exceeding 49% torque. Oil pressure below 60 psi is unsafe. It requires that either the engine be shut down, or that a landing be made at the nearest suitable airport, using the minimum power required to sustain flight. Fluctuations of ± 10 psi are acceptable.

(3) A minimum oil temperature of 55 °C is recommended for fuel heater operation at takeoff power.

(4) Oil temperature limits are -40 °C and 99 °C. However, temperatures of up to 104 °C are permitted for a maximum time of 10 minutes.

(5) These values are time limited to 5 seconds.

(6) High ITT at ground idle may be corrected by reducing accessory load or increasing N_1 RPM.

(7) At approximately 70% N_1.

(8) Cruise torque values vary with altitude and temperature.

(9) This operation is time limited to 1 minute.

(10) These values are time limited to 10 seconds.

(11) Values above 99 °C are time limited to 5 minutes.

Table 5-2. Engine Operating Limitations **T3** **F3**

OPERATING CONDITION	SHP	TORQUE FT-LB (1)	MAXIMUM OBSERVED ITT ºC	GAS GENERATOR RPM N_1 %	PROP RPM N_2	OIL PRESS PSI (2)	OIL TEMP ºC (3) (4)
STARTING	– – –	– – –	1000 (5)	– – –	– – –	– – –	-40 (min)
LOW IDLE	– – –	– – –	750 (6)	58 (min)	– – –	60 (min)	-40 to 99
HIGH IDLE	– – –	– – –	– – –	(7)	– – –	– – –	-40 to 99
TAKEOFF & MAX CONT	850	2230	800	101.5	2000	100-135	0 to 99
MAX CRUISE	850	2230 (8)	800	101.5	2000	100-135	0 to 99
CRUISE CLIMB AND REC (NORMAL) CRUISE	850	2230 (8)	770	101.5	2000	100-135	0 to 99
MAX REVERSE (9)	800	– – –	750	88	1900	100-135	0 to 99
TRANSIENT	– – –	2750 (5)	850	102.6 (10)	2200 (5)	– – –	104 (11)

TABLE NOTES:

(1) Torque limit applies within range of 1600-2000 propeller RPM (N_2). Below 1600 RPM, torque is limited to 1100 ft-lb.

(2) When gas generator speeds are above 72% N_1 and oil temperatures are between 60 °C and 71 °C, normal oil pressures are: 100 to 135 psi below 21,000 feet and 85 to 135 psi at 21,000 feet and above.

During extremely cold starts, oil pressure may reach 200 psi. Oil pressure between 60 to 85 psi is undesirable; it should be tolerated only for the completion of the flight, and then only at a reduced power setting not exceeding 1100 ft-lb torque. Oil pressure below 60 psi is unsafe; it requires that either the engine be shut down, or that a landing be made as soon as possible, using the minimum power required to sustain flight. Fluctuations of ± 10 psi are acceptable.

(3) An engine oil temperature of 74 to 80 °C is recommended. A minimum oil temperature of 55 °C is recommended for fuel heater operation at takeoff power.

(4) Oil temperature limits are -40 °C and 99 °C. However, temperatures of up to 104 °C are permitted for a maximum time of 10 minutes.

(5) These values are time limited to 5 seconds.

(6) High ITT at ground idle may be corrected by reducing accessory load and/or increasing N_1 RPM.

(7) At approximately 70% N_1.

(8) Cruise torque values vary with altitude and temperature.

(9) This operation is time limited to 1 minute.

(10) These values are time limited to 10 seconds.

(11) Values above 99 °C are time limited to 10 minutes.

Table 5-3. Generator Load Limits

GENERATOR LOAD	MINIMUM GAS GENERATOR RPM – N_1 WITHOUT AIR CONDITIONING	MINIMUM GAS GENERATOR RPM – N_1 WITH AIR CONDITIONING *
T3 F3 0% to 75%	58%	62%
75% to 80%	60%	62%
R 0% to 80%	61%	62%
R, T3 F3 80% to 85%	65%	65%

* *Right engine only*

Section IV. LOADING LIMITS

5-17. CENTER OF GRAVITY LIMITATIONS.

Center of gravity limits and instructions for computation of the center of gravity are contained in Chapter 6. The center of gravity range will remain within limits, providing the aircraft loading is accomplished according to instructions in Chapter 6.

5-18. WEIGHT LIMITATIONS.

WARNING

The ability to experience loss of engine power and successfully stop, continue the takeoff, or climb, before or after gear retraction, is not assured for all conditions. Thorough mission planning must be accomplished prior to takeoff, by analysis of maximum takeoff weight permitted by takeoff distance, accelerate-stop, positive one engine inoperative climb at lift off, accelerate-go, takeoff climb gradient, and climb performance. This data will describe performance capabilities for critical mission decisions.

a. Operations At Or Below 12,500 Pounds Gross Takeoff Weight (GTOW).

(1) Takeoff. Maximum GTOW is 12,500 pounds.

(2) Landing. Maximum gross landing weight is 12,500 pounds

(3) Maximum Ramp Weight. Maximum ramp weight is 12,590 pounds.

(4) Maximum Zero Fuel Weight. Maximum zero fuel weight is 11,000 pounds.

(5) Altitude.

(a) At least 75% of total missions shall be flown at altitudes above 5,000 feet above ground level when operating at or below 12,500 pounds GTOW.

(b) At least 50% of total missions shall be flown at altitudes above 10,000 feet above ground level when operating at or below 12,500 pounds GTOW.

b. Operations Over 12,500 Pounds GTOW.

(1) Requirements.

WARNING

Artificial stall warning systems may only provide a 1 to 5 knot stall warning.

CAUTION

Maximum GTOW charts must be strictly followed in the event of an engine failure.

(a) Aircraft shall be equipped with Raisbeck Engineering dual aft body strakes and engine ram air recovery system with PT6A-42 engines.

(b) Landing. Maximum landing weight is 12,500 pounds, unless required by an emergency. If it is necessary to land with a weight over 12,500 pounds, the landing shall be made on a smooth, paved runway at a sink rate of 500 feet per minute or less, if possible.

(c) Altitude. All missions with over 12,500 pounds GTOW shall be planned and flown at or above 10,000 feet above ground level.

(d) Flight Duration. All missions with over 12,500 pounds GTOW shall have a minimum duration of 60 minutes unless restricted by Air Traffic Control (ATC), turbulence, other weather conditions, or emergencies.

(e) Takeoff. All takeoffs with over 12,500 pounds GTOW shall be accomplished from a smooth, paved runway. Takeoffs shall not be performed with a tailwind.

(2) Maximum Weight Operation.

(a) Takeoff. Maximum gross takeoff weight is 14,000 pounds.

(b) Landing. Maximum gross landing weight is 12,500 pounds.

(c) Maximum Ramp Weight. Maximum ramp weight is 14,090 pounds.

(d) Maximum Zero Fuel Weight. Maximum zero fuel weight is 11,000 pounds.

5-19. CABIN AIRSTAIR DOOR WEIGHT LIMITATION.

The maximum weight that may be placed on the steps of the cabin airstair door is 300 pounds.

5-20. TOILET WEIGHT LIMITATION.

The maximum weight of a person occupying the toilet during takeoff or landing shall not exceed 238 pounds.

Section V. AIRSPEED LIMITS, MAXIMUM AND MINIMUM

5-21. AIRSPEED LIMITATIONS.

All placarded airspeeds and airspeed indicator readings contained in procedures, text, and illustrations throughout this Operator's Manual are given as Indicated Airspeed (IAS) unless otherwise noted.

5-22. MAXIMUM ALLOWABLE AIRSPEED.

The maximum allowable airspeed is 259 KIAS below 11,500 feet, and M_{mo} of 0.52 Mach as indicated by the maximum allowable airspeed pointer (red striped) between 11,500 feet and 35,000 feet.

5-23. LANDING GEAR EXTENSION/EXTENDED SPEED.

The airspeed limit for extending the landing gear and for flight with the landing gear extended is 181 KIAS.

5-24. LANDING GEAR RETRACTION SPEED.

The airspeed limit for retracting the landing gear is 163 KIAS.

5-25. WING FLAP EXTENSION SPEEDS.

The airspeed limit for **APPROACH** extension, 40%, of the wing flaps is 200 KIAS. The airspeed limit for flap positions beyond **APPROACH** is 157 KIAS (V_{fe}). If wing flaps are extended above these speeds, the flaps or their operating mechanisms may be damaged.

5-26. MINIMUM SINGLE ENGINE CONTROL AIRSPEED (V_{mca}).

The minimum single engine control airspeed (V_{mca}) at sea level standard conditions is 86 KIAS.

5-27. MAXIMUM DESIGN MANEUVERING SPEED.

The maximum design maneuvering speed is 181 KIAS.

5-28. TIRE LIMITATION.

a. Tire limitation for high flotation gear is 139 knots (160 mph).

b. Standard Gear. Tire limitation for standard gear is 156 knots (180 mph).

Section VI. MANEUVERING LIMITS

5-29. MANEUVERS.

a. The following maneuvers are prohibited.

(1) Spins.

(2) Aerobatics of any kind.

(3) Abrupt maneuvers above 181 KIAS.

b. Flight Load Factor Limits (12,500 Pounds). Any maneuver which results in a positive load factor of 3.17 G's or a negative load factor of 1.27 G's with wing flaps up; or a positive load factor of 2.0 G's, or a negative load factor of 0 G's with flaps down.

c. Flight Load Factor Limits (14,000 Pounds). Any maneuver which results in a positive load factor of 3.10 G's or a negative load factor of 1.24 G's with wing flaps up; or a positive load factor of 2.0 G's, or 0 G's with flaps down.

d. Recommended turbulent air penetration airspeed is 170 KIAS.

5-30. BANK AND PITCH LIMITS.

a. Bank limits are 60° left or right.

b. Pitch limits are 30° above or below the horizon.

Section VII. ENVIRONMENTAL RESTRICTIONS

5-31. ALTITUDE LIMITATIONS.

The maximum altitude at which the aircraft may be operated is 35,000 feet, but not to exceed a cabin pressure altitude of 10,000 feet IAW AR 95-1.

5-32. TEMPERATURE LIMITS.

a. The aircraft shall not be operated when the ambient temperatures are warmer than ISA +37 °C at sea level to 25,000 feet, or ISA +31 °C above 25,000 feet.

b. The ice vanes shall be extended for operations in ambient temperatures of +5 °C or below when flight free of visible moisture cannot be assured. For takeoff and flight operations, the ice vanes shall be retracted at +15°C. Minimum free air temperature for operation of deicing boots shall be –40 °C.

5-33. FLIGHT UNDER INSTRUMENT METEOROLOGICAL CONDITIONS (IMC).

This aircraft is qualified for operation in instrument meteorological conditions.

5-34. ICING LIMITATIONS (TYPICAL).

WARNING

While in icing conditions, if there is an unexplained 30% increase of torque needed to maintain airspeed in level flight, a cumulative total of 2 or more inches of ice accumulation on the wing, an unexplained decrease of 15 KIAS, or an unexplained deviation between pilot's and copilot's airspeed indicators, the icing environment should be exited as soon as practicable. Ice accumulation on the pitot tube assemblies could cause a complete loss of airspeed indication.

a. The following conditions indicate a possible accumulation of ice on the pitot tube assemblies and unprotected aircraft surfaces. If any of these conditions are observed, the icing environment should be exited as soon as practicable.

(1) If there has been a total ice accumulation of 2 inches or more on the wing surfaces, exit the icing environment as soon as practicable. Determination of ice thickness on unprotected areas can be accomplished by summing the estimated ice thickness on the wing prior to each pneumatic boot deice cycle (i.e., four cycles of minimum recommended ½-inch accumulation).

(2) If there is a 30% increase in torque per engine required to maintain a desired airspeed in level flight, not to exceed 85% torque, when operating at recommended holding speed, exit the icing environment as soon as practicable.

(3) If there is a decrease in indicated airspeed of 15 knots after entering the icing condition, not slower than 1.4 times the power off stall speed, if maintaining original power setting in level flight, exit the icing environment as soon as practicable. This can be determined by comparing pre-icing condition entry speed to the indicated speed after a surface deice cycle is completed. The minimum indicated airspeed in sustained icing conditions is 140 KIAS.

(4) If there are any variations from normal IAS between the pilot's and copilot's airspeed indicators, exit the icing environment as soon as practicable.

5-35. ICING LIMITATIONS (SEVERE).

WARNING

Severe icing may result from environmental conditions outside of those for which the aircraft is certified. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in a buildup on protective surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of these protected surfaces. This ice may not shed using ice protection systems, and may seriously degrade the performance and controllability of the aircraft.

NOTE

All icing detection lights must be operative prior to flight into icing conditions at night. This supersedes any relief provided by the Master Minimum Equipment List or equivalent.

a. During flight, severe icing conditions that exceed those for which the aircraft is certified shall be determined by the following visual cues. If one or more of these visual cues exist, immediately request priority handling from air traffic control to facilitate a route or an altitude change to exit the icing conditions.

1. Unusually extensive ice accreted on the airframe in areas not normally observed to collect ice;

2. Accumulation of ice on the upper (or lower, as appropriate) surface of the wing aft of the protected area; or

3. Accumulation of ice on the propeller spinner farther aft than normally observed.

b. Since the autopilot may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when any of the visual cues specified above exist, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the aircraft is in icing conditions.

5-36. CROSSWIND LIMITATIONS.

WARNING

Landing with wind conditions in excess of the demonstrated crosswind component may result in damage to the aircraft. This should only be attempted during emergency situations.

The maximum demonstrated crosswind component is 25 knots at 90°.

5-37. OXYGEN REQUIREMENTS.

a. Oxygen requirements will be in accordance with AR 95-1.

b. Oxygen system data/duration tables are found in Chapter 2.

5-38. CABIN PRESSURE LIMITS.

Maximum cabin differential pressure is 6.6 psi.

5-39. CRACKED WINDSHIELD.

NOTE

Heating elements may be inoperative in area of crack.

a. External Crack In-flight. If an external windshield crack is noted, no action is required in flight.

b. Internal Crack In-flight. If it is determined that an internal crack has occurred in flight, perform the Internal Crack In-flight procedure in Chapter 9.

c. External Crack on Ground. If the cracking of only the windshield's outer ply is observed on the ground, unpressurized flight may be conducted provided the following procedures are observed:

1. Cracking must not significantly impair visibility.

2. Cracking must not interfere with use of windshield wipers.

3. Heating elements must be operative for flight into icing.

4. A temporary placard must be fabricated and placed in clear view of the pilot until the windshield is replaced. The placard should read as follows:

DUE TO A CRACK IN THE WINDSHIELD, PRESSURIZED FLIGHT IS PROHIBITED. CONDUCT FLIGHTS WITH BLEED AIR VALVES IN ENVIR OFF POSITION AND CABIN PRESS SWITCH IN DUMP POSITION.

d. Internal Crack on Ground. Inner ply cracking is not a structural consideration for replacement prior to next flight, but one of possible glass flaking which could interfere with pilot vision.

5-40. CRACKED CABIN WINDOW.

If crack(s) in cabin window ply(s) occurs in-flight, perform the Cracked Cabin Window emergency procedure in Chapter 9. If a cabin window has developed a crack, the aircraft shall not be flown, once landed, without proper ferry flight authorization.

If cracking, chipping, or stress crazing that can be felt with the fingernail occurs in either ply of the cabin window, the window should be replaced in accordance with the approved maintenance instructions.

If, for some reason, the window cannot be replaced prior to the next flight, unpressurized flight may be conducted, provided the following placards are installed in the aircraft.

The following placard must be placed in clear view of the pilot:

PRESSURIZED FLIGHT IS PROHIBITED DUE TO A DAMAGED WINDOW. CONDUCT FLIGHT WITH THE CABIN PRESS SWITCH IN THE DUMP POSITION.

The following placard must be placed next to the pressurization control:

UNPRESSURIZED FLIGHT ONLY PERMITTED.

If a crack is found in both the inner and outer plies of the cabin window, the window must be replaced PRIOR TO FURTHER FLIGHT OF THE AIRCRAFT, unless proper ferry flight authorization has been obtained.

Section VIII. OTHER LIMITATIONS

5-41. INTENTIONAL ENGINE OUT SPEED.

Intentional in-flight engine cuts below the safe one engine inoperative speed (V_{sse}, 104 KIAS) are prohibited.

5-42. LANDING ON UNPREPARED RUNWAY.

CAUTION

Except in an emergency, propellers should be moved out of reverse below 40 knots to minimize propeller blade erosion, and during crosswind to minimize stress imposed on propellers, engines, and airframe. Care must be exercised when reversing on runways with loose sand or dust on the surface. Flying gravel will damage propeller blades and dust may impair the pilot's forward visibility at low aircraft speeds.

The aircraft has demonstrated landings on hard, smooth runways. Hard braking, i.e., skidding tires while operating on other than smooth runways, can result in damage to the landing gear. When landing on other than dry surfaces, use discretionary propeller reverse to stop the aircraft on the available runway.

Section IX. REQUIRED EQUIPMENT FOR VARIOUS CONDITIONS OF FLIGHT

5-43. REQUIRED EQUIPMENT LISTING.

The Required Equipment List (REL) is approved by the Directorate of Evaluation and Standardization (DES) USAAVNC, Fort Rucker. It is fully coordinated with the Master Minimum Equipment List (MMEL) and AR 95-1. It is the governing document for flight with inoperative components and items of equipment. Changes or modification to the REL are not authorized unless approved by DES and distributed by the Fixed Wing Product Manager’s Office (FWPMO). Place the current REL in this section.

CHAPTER 6
WEIGHT/BALANCE AND LOADING

Section I. GENERAL

6-1. EXTENT OF COVERAGE.

Sufficient data has been provided so that, knowing the basic weight and moment of the aircraft, any combination of weight and balance can be computed.

6-2. CLASS.

Army models C-12R, C-12T3, and C-12F3 aircraft are in Weight and Balance Class 2. Additional directives governing weight and balance of Class 2 aircraft forms and records are contained in AR 95-1, TM 55-1500-342-23, and DA PAM 738-751.

6-3. AIRCRAFT COMPARTMENTS AND STATIONS.

The aircraft is separated into two compartments associated with loading. These compartments are the cockpit and the cabin. Figure 6-1, Sheets 1 through 3, illustrates the general description of the aircraft compartments in the passenger configuration.

Section II. WEIGHT AND BALANCE

6-4. PURPOSE.

The data to be inserted on weight and balance charts and forms are applicable only to the individual aircraft, the serial number of which appears on the title page of the booklet entitled *Weight And Balance Data*, supplied by the aircraft manufacturer and on the various forms and charts which remain with the aircraft. The charts and forms referred to in this chapter may differ in nomenclature and arrangement from time to time, but the principles on which they are based will not change.

6-5. CHARTS AND FORMS.

The standard system of weight and balance control requires the use of several different charts and forms. Within this chapter, the following are used:

- Chart C - Basic Weight and Balance Record, DD Form 365-3.
- Form F - Weight and Balance Clearance Form F, DD Form 365-4. (Transport).

6-6. RESPONSIBILITY.

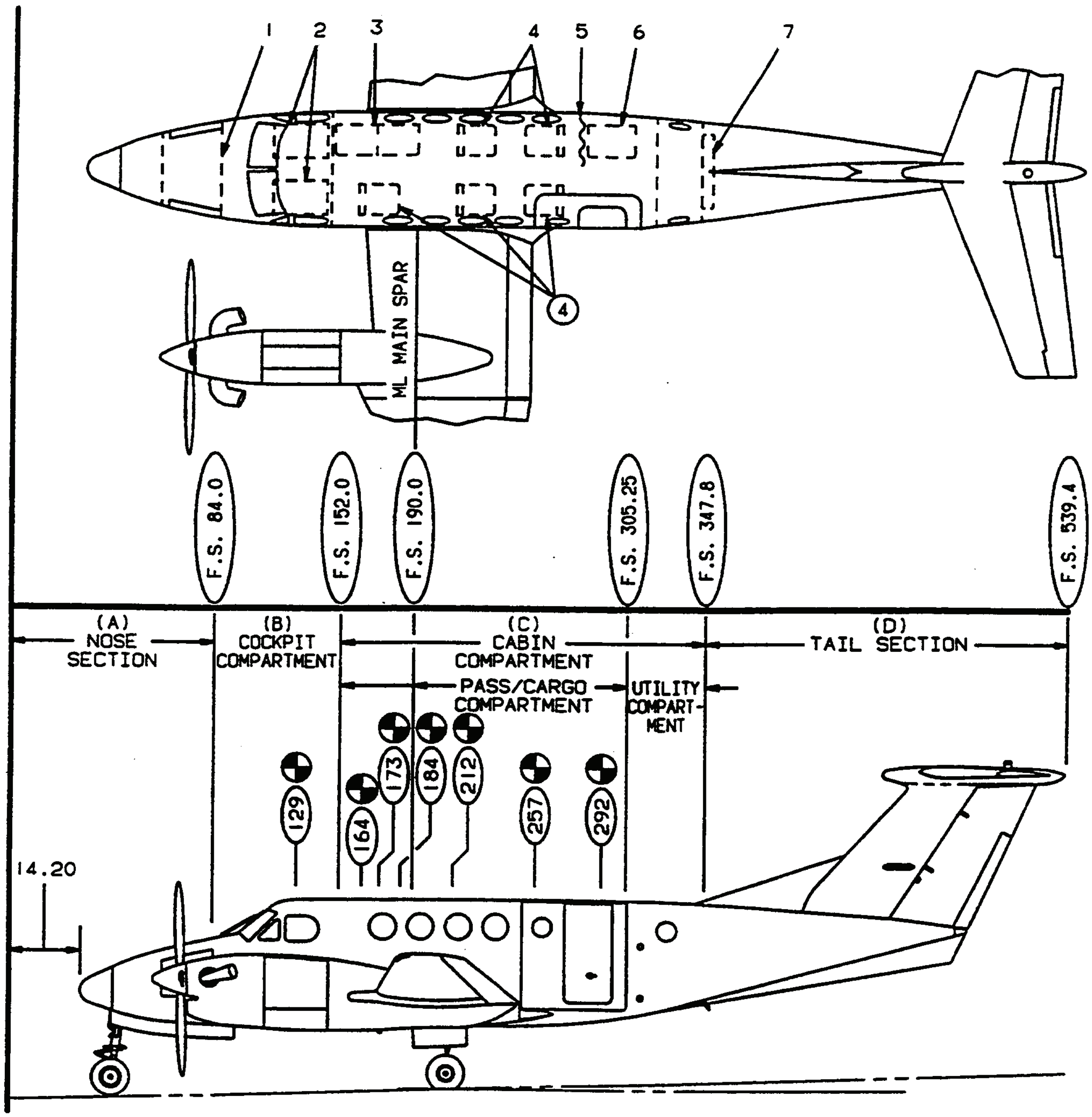
The aircraft manufacturer inserts all aircraft identifying data on the title page of the booklet entitled *Weight And Balance Data* and on the various charts and forms. All charts, including one sample Weight and Balance Clearance Form F, if applicable, are completed at time of delivery. This record is the basic weight and balance data of the aircraft at delivery. All subsequent changes in weight and balance are compiled by the weight and balance technician.

6-7. CHART C - BASIC WEIGHT AND BALANCE RECORD, DD FORM 365-3.

Chart C is a continuous history of the basic weight and moment resulting from structural and equipment changes made in service. At all times, the last weight and moment/100 entry is considered the current weight and balance status of the basic aircraft.

6-8. WEIGHT AND BALANCE CLEARANCE FORM F, DD FORM 365-4.

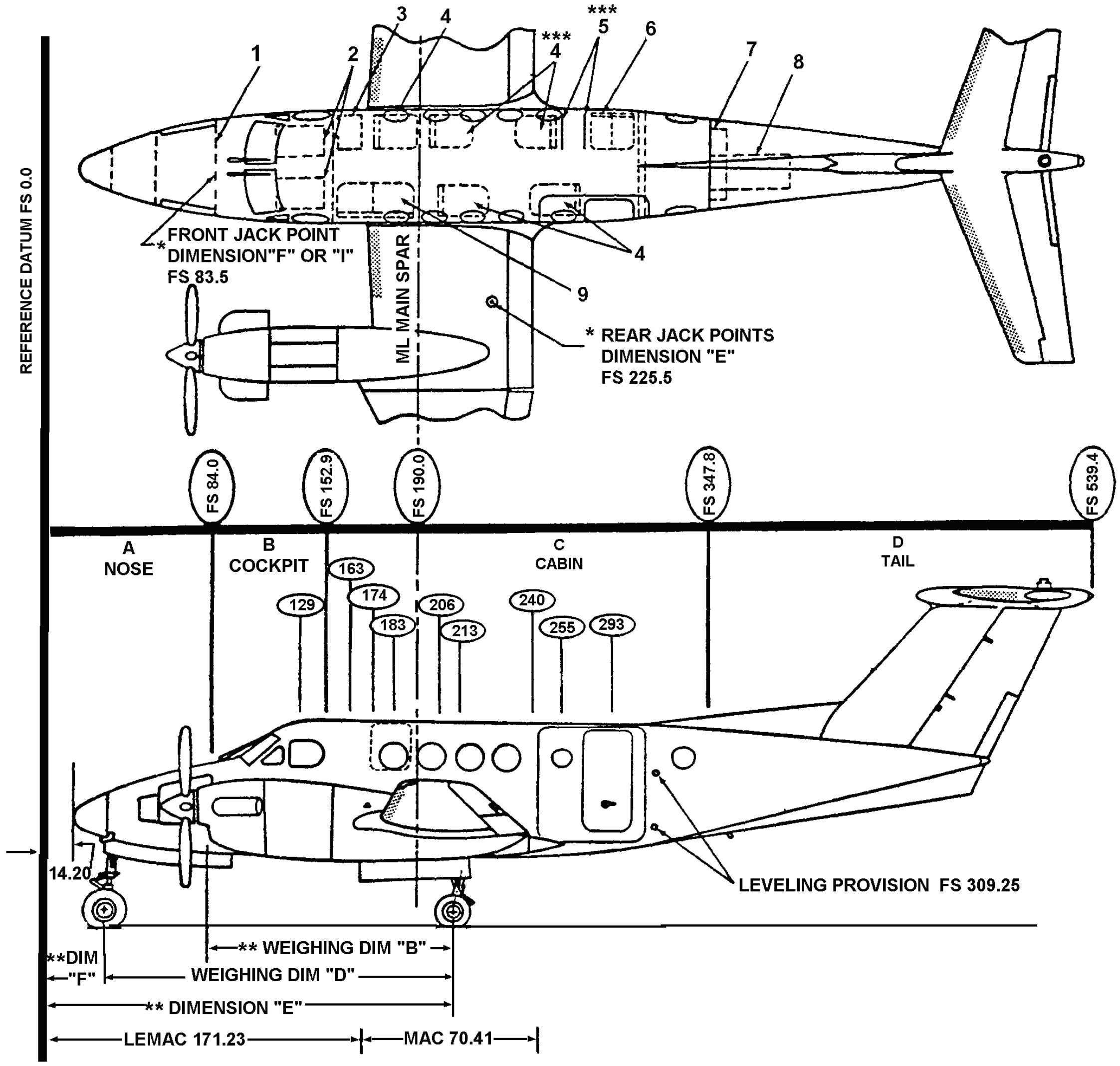
Refer to TM 55-1500-342-23 for Form F, 365-4 instructions. Refer to Tables 6-1 through 6-3 for weight and balance data.



1. Avionics Compartment
2. Pilot and Copilot Seats
3. Two Place Couch
4. Passenger Seats (5)
5. Privacy Curtain
6. Lavatory
7. Avionics Shelves, Oxygen Bottle

⊕ Denotes seating Centroids

Figure 6-1. Airplane Diagram – Passenger R (Sheet 1 of 3)



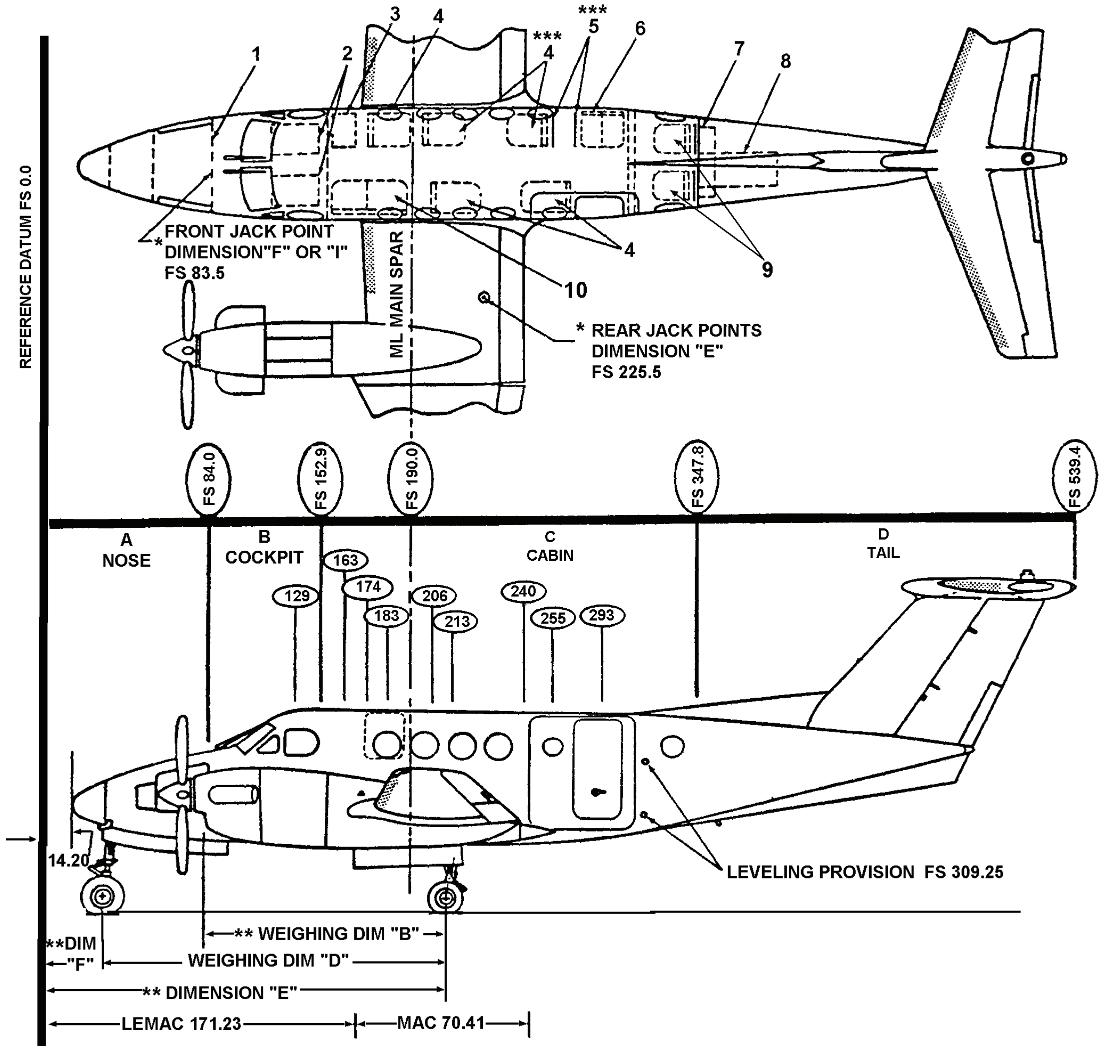
* ACTUAL MEASUREMENTS DURING WEIGHING ARE NOT NECESSARY. AFTER LEVELING THE AIRCRAFT, THESE DIMENSIONS FOR "E" AND "F" MAY BE INSERTED DIRECTLY IN THE WEIGHING FORM.

** MEASURE DIMENSIONS"B" AND "D" DURING WEIGHING. USING THESE ACTUAL DIMENSIONS AND THE JIG POINT DIMENSION "I", DETERMINE "E" AND "F".

*** OPTIONAL PASSENGER CONFIGURATION - CONSISTS OF REMOVAL OF FORWARD PARTITION OF BAGGAGE ENCLOSURE AND A REPOSITIONED RIGHT AFT SEAT FROM FS 240 TO FS 248.

1. **Avionics Compartment**
2. **Pilot's and Copilot's Seats**
3. **Refreshment Bar**
4. **Passenger Seats (5)**
5. **Baggage Partitions & Privacy Curtain**
6. **Lavatory**
7. **Oxygen Bottle**
8. **Avionics Shelves; F800 Flight Data Recorder, A100A Voice Recorder, KTR-950 HF And Components, GNS-500A Receiver Computer and Optional Equipment Unit, VHF-22B Comm (2), & AA-300 Radio Altimeter, PS-835D Battery Pack**
9. **Two Place Couch**

Figure 6-1. Airplane Diagram – Passenger T3 F3 OSA (Sheet 2 of 3)



* ACTUAL MEASUREMENTS DURING WEIGHING ARE NOT NECESSARY. AFTER LEVELING THE AIRCRAFT, THESE DIMENSIONS FOR "E" AND "F" MAY BE INSERTED DIRECTLY IN THE WEIGHING FORM.

** MEASURE DIMENSIONS"B" AND "D" DURING WEIGHING. USING THESE ACTUAL DIMENSIONS AND THE JIG POINT DIMENSION "I", DETERMINE "E" AND "F".

*** OPTIONAL PASSENGER CONFIGURATION - CONSISTS OF REMOVAL OF FORWARD PARTITION OF BAGGAGE ENCLOSURE AND A REPOSITIONED RIGHT AFT SEAT FROM FS 240 TO FS 248.

1. Avionics Compartment: SRU-706 & SBU-706 TACAN, VIR-32 NAV (2), DME-42, PRIMUS 300SL RADAR, C-14A-43 COMPASS (2), ADF-60A, VG14A (2), FZ-400 Flight Control Computer (2), AZ-600 Air Data Computer, DATA NAV IV Interface Computer, GCAS
2. Pilot's And Copilot's Seats
3. Refreshment Bar
4. Passenger Seats (5)
5. Baggage Partitions & Privacy Curtain
6. Lavatory
7. Oxygen Bottle
8. Avionics Shelves: KTR-950 HF and Components, GNS-500A Receiver Computer And Optional Equipment Unit, VHF-22B COMM (2), & AA-300 Radio Altimeter, PS-835D Battery Pack
9. Fold-Up Seats
10. Two Place Couch

Figure 6-1. Airplane Diagram – Passenger T3 F3 ANG (Sheet 3 of 3)

Table 6-1. Useful Load Weights and Moments – Occupants

WEIGHT	CREW	TWO PLACE COUCH		PASSENGER SEATS			LAVATORY
	F.S. 129	F.S. 164	F.S. 184	F.S. 173	F.S. 212	F.S. 257	F.S. 292
	MOMENT/100						
80	103	131	147	138	170	206	234
90	116	148	166	156	191	231	263
100	129	164	184	173	212	257	292
110	142	180	202	190	233	283	321
120	155	197	221	208	254	308	350
130	168	213	239	225	276	334	380
140	181	230	258	242	297	360	409
150	194	246	276	260	318	386	438
160	206	262	294	277	339	411	467
170	219	279	313	294	360	437	496
180	232	295	331	311	382	463	526
190	245	312	350	329	403	488	555
200	258	328	368	346	424	514	584
210	271	344	386	363	445	540	613
220	284	361	405	381	466	565	642
230	297	377	423	398	488	591	672
240	310	394	442	415	509	617	701
250	323	410	460	433	530	643	730

Table 6-2. Useful Load Weights and Moments – Baggage

WEIGHT	AFT CABIN F.S. 325 MOMENT/100	WEIGHT	AFT CABIN F.S. 325 MOMENT/100
10	33	90	293
20	65	100	325
30	98	200	650
40	130	300	975
50	163	400	1300
60	195	500	1625
70	228	550	1788
80	260		

NOTE

For T3 (ANG), the aft baggage compartment limit is 510 pounds with the folding seats installed.

Table 6-3. Useful Load Weights and Moments – Cargo

WEIGHT	CABIN			
	F.S. 152-188	F.S. 188-248	F.S. 248-305	F.S. 305-348
	CENTROID			
	F.S. 170	F.S. 218	F.S. 276	F.S. 325
	MOMENT/100NT/100			
10	17	22	28	33
20	34	44	55	65
30	51	65	83	98
40	68	87	110	130
50	85	109	138	163
60	102	131	166	195
70	119	153	193	228
80	136	174	221	260
90	153	196	248	293
100	170	218	276	325
200	340	436	552	650
300	510	654	828	975
400	680	872	1104	1300
500	850	1090	1380	1625
510	867	1112	1408	1658
550	935	1199	1518	1788
600	1020	1308	1656	–
700	1190	1526	1932	–
800	1360	1744	2208	–
900	–	1962	2484	–
1000	–	2180	2760	–
1100	–	2398	3036	–
1200	–	2616	3312	–
1300	–	2834	3588	–
1370	–	–	3781	–

NOTE: All cargo must be supported by the seat tracks in a uniform distribution and tied down to the tracks by an approved method.

Section III. FUEL/OIL

6-9. FUEL LOAD.

Fuel loading imposes a restriction on the amount of load that can be carried. The required fuel must first be determined, then that weight subtracted from the allowable takeoff weight in order to determine the allowable load. Correct performance planning is the primary determinate of the fuel load. As the fuel load is increased, the loading capacity is reduced. Figure 6-2 depicts the density variation of aviation fuel.

DENSITY VARIATION OF AVIATION FUEL
BASED ON AVERAGE SPECIFIC GRAVITY

FUEL	AVERAGE SPECIFIC GRAVITY
JET A (JP-5, JP-8) AND JET A1	0.819 AT 15 °C
JET B (JP-4)	0.764 AT 15 °C
AV GAS GRADE100/130	0.706 AT 15 °C

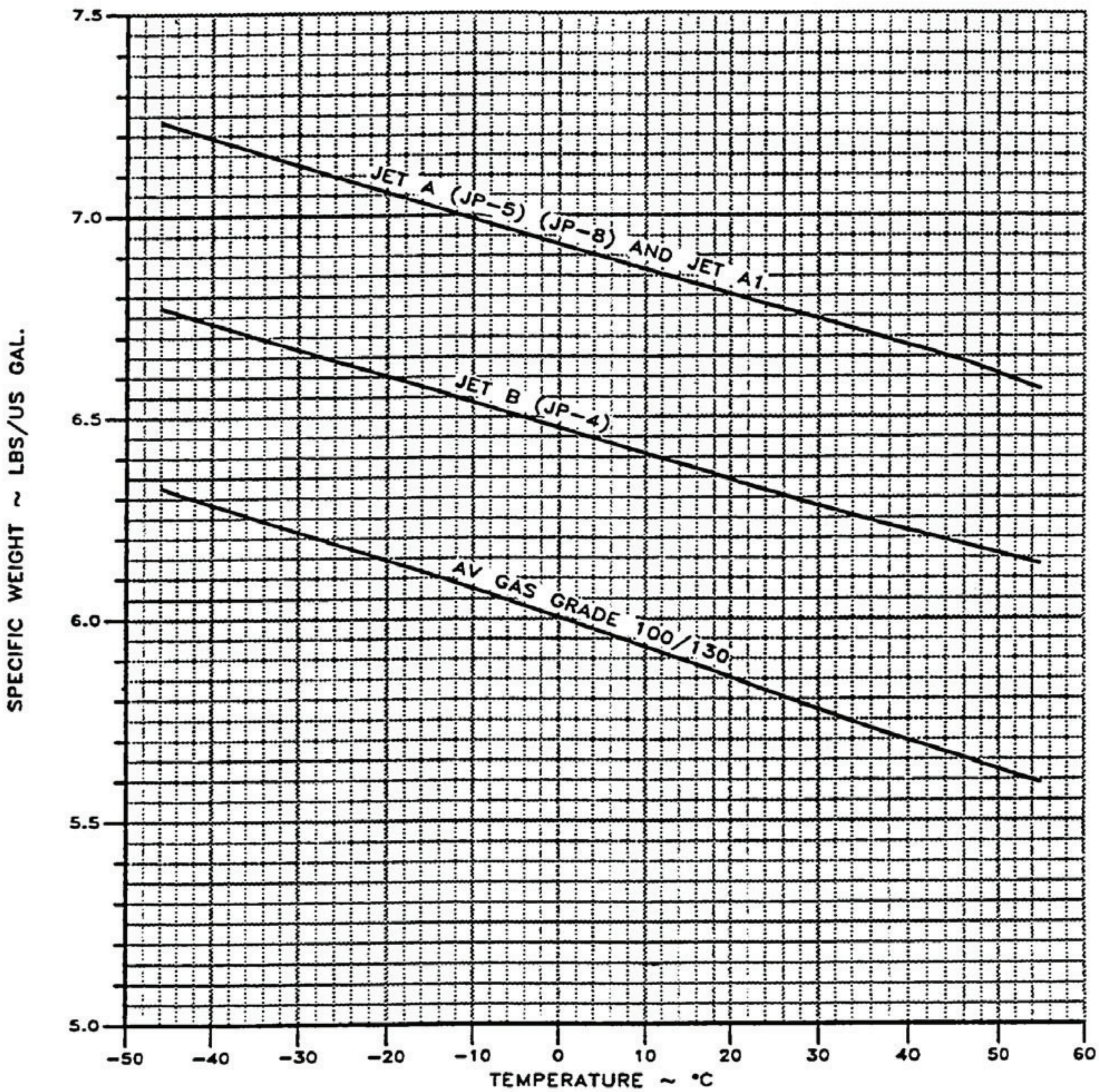


Figure 6-2. Density Variation of Aviation Fuel

6-10. FUEL AND OIL DATA.

a. Fuel Moment Tables. Tables 6-4 and 6-5 show usable fuel moment/100 for U.S. gallons or pounds of fuel specific weights from 6.4 to 6.8 lb/gal.

The full tank usable fuel weight will vary depending upon fuel specific weight. The fuel quantity indicator is calibrated for correct indication when using JP-5 or JP-8. When using other fuels, multiply the indicated fuel quantity in pounds by 0.99 for JP-4 or by 0.98 for aviation gasoline (100/130).

Figure 6-2 is provided to show the general range of fuel specific weights to be expected with change in fuel temperature. Specific weight may also vary between lots of the same type fuel at the same temperature by as much as 0.5 lb/gal.

Table 6-4. Useful Load Weights and Moments, Usable Fuel 6.4 to 6.7 Lb/Gal

GAL	6.4 LB/GAL		6.5 LB/GAL		6.6 LB/GAL		6.7 LB/GAL	
	WEIGHT	MOMENT/ 100	WEIGHT	MOMENT/ 100	WEIGHT	MOMENT/ 100	WEIGHT	MOMENT/ 100
10	64	99	65	100	66	102	67	103
20	128	197	130	200	132	203	134	206
30	192	305	195	310	198	314	201	319
40	256	423	260	430	264	436	268	443
50	320	542	325	550	330	559	335	567
60	384	662	390	672	396	683	402	693
70	448	782	455	794	462	807	469	819
80	512	904	520	918	528	932	536	946
90	576	1023	585	1039	594	1055	603	1071
100	640	1142	650	1160	660	1178	670	1196
110	704	1260	715	1280	726	1300	737	1319
120	768	1379	780	1400	792	1422	804	1443
130	832	1496	845	1519	858	1543	871	1566
140	896	1615	910	1640	924	1665	938	1690
150	960	1734	975	1761	990	1788	1005	1815
160	1024	1852	1040	1881	1056	1910	1072	1939
170	1088	1971	1105	2002	1122	2033	1139	2064
180	1152	2090	1170	2122	1188	2155	1206	2188
190	1216	2209	1235	2244	1254	2279	1273	2313
200	1280	2328	1300	2365	1320	2401	1340	2437
210	1344	2447	1365	2486	1386	2524	1407	2562
220	1408	2567	1430	2607	1452	2647	1474	2687
230	1472	2686	1495	2728	1518	2770	1541	2812
240	1536	2806	1560	2850	1584	2894	1608	2938
250	1600	2926	1625	2971	1650	3017	1675	3063
260	1664	3045	1690	3093	1716	3140	1742	3188
270	1728	3164	1755	3213	1782	3263	1809	3312
280	1792	3283	1820	3334	1848	3386	1876	3437
290	1856	3402	1885	3455	1914	3508	1943	3562
300	1920	3521	1950	3576	1980	3631	2010	3686

Table 6-4. Useful Load Weights and Moments, Usable Fuel 6.4 to 6.7 Lb/Gal (Continued)

GAL	6.4 LB/GAL		6.5 LB/GAL		6.6 LB/GAL		6.7 LB/GAL	
	WEIGHT	MOMENT/ 100	WEIGHT	MOMENT/ 100	WEIGHT	MOMENT/ 100	WEIGHT	MOMENT/ 100
310	1984	3641	2015	3698	2046	3754	2077	3811
320	2048	3760	2080	3819	2112	3878	2144	3936
330	2112	3880	2145	3940	2178	4001	2211	4062
340	2176	3999	2210	4062	2244	4124	2278	4187
350	2240	4119	2275	4184	2310	4248	2345	4312
360	2304	4244	2340	4310	2376	4377	2412	4443
370	2368	4365	2405	4434	2442	4502	2479	4570
380	2432	4489	2470	4560	2508	4630	2546	4700
386	2470	4562	2509	4634	2548	4706	2586	4776
400	2560	4741	2600	4815	2640	4889	2680	4963
410	2624	4869	2665	4945	2706	5021	2747	5097
420	2688	4997	2730	5075	2772	5153	2814	5231
430	2752	5126	2795	5206	2838	5286	2881	5336
440	2816	5255	2860	5337	2904	5419	2948	5501
450	2880	5386	2925	5470	2970	5554	3015	5638
460	2944	5514	2990	5600	3036	5686	3082	5773
470	3008	5645	3055	5733	3102	5821	3149	5909
480	3072	5775	3120	5866	3168	5956	3216	6046
490	3136	5907	3185	5999	3234	6091	3283	6184
500	3200	6040	3250	6134	3300	6229	3350	6323
510	3264	6172	3315	6269	3366	6365	3417	6462
520	3328	6307	3380	6405	3432	6504	3484	6602
530	3392	6441	3445	6542	3498	6643	3551	6743
540	3456	6573	3510	6676	3564	6779	3618	6881
544	3482	6626	3536	6729	3590	6832	3645	6936

Table 6-5. Useful Load Weights and Moments, Usable Fuel 6.8 Lb/Ga

GALLONS	6.8 LB/GAL		GALLONS	6.8 LB/GAL	
	WEIGHT	MOMENT/ 100		WEIGHT	MOMENT/ 100
10	68	105	310	2108	3868
20	136	209	320	2176	3995
30	204	324	330	2244	4123
40	272	450	340	2312	4249
50	340	575	350	2380	4376
60	408	703	290	1972	3615
70	476	831	300	2040	3741
80	544	960	360	2448	4509
90	612	1087	370	2516	4638
100	680	1214	380	2584	4770
110	748	1339	386	2625	4848
120	816	1465	400	2720	5037
130	884	1589	410	2788	5173
140	952	1715	420	2856	5309
150	1020	1842	430	2924	5446
160	1088	1968	440	2992	5583
170	1156	2095	450	3060	5722
180	1224	2221	460	3128	5859
190	1292	2348	470	3196	5997
200	1360	2473	480	3264	6136
210	1428	2600	490	3332	6276
220	1496	2727	500	3400	6418
230	1564	2854	510	3468	6558
240	1632	2982	520	3536	6700
250	1700	3109	530	3604	6844
260	1768	3236	540	3672	6984
270	1836	3361	544	3699	7039
280	1904	3488			

b. Table 6-6 shows basic weight and balance information for ferry fuel system components.

NOTE

This is a typical installation configuration. Particular installations may differ. Refer to the aircraft's DD Form 365-3 Chart C to determine the CG for each tank to determine fuel moment loading.

Table 6-6. Ferry Fuel Components

COMPONENT	WEIGHT	CG	MOMENT
Fuel Pumps, Lines, and Valves	28.0	185.0	5180.0
Fuel Tanks and Platforms	102.0	218.0	22236.0
Surge Tanks and Vent Lines	18.0	209.0	3762.0

c. Oil Data. Total oil weight is 52 pounds and is included in the basic weight of the aircraft.

Section IV. PERSONNEL

6-11. CABIN AREA.

a. Cabin. The cabin extends from the back of the cockpit partition to the aft cabin wall. Refer to Figure 6-1. This area provides 253.0 cubic feet of space. The cabin is 57.0 inches high and 54.0 inches wide. Access is gained through the entrance door, which measures 46 inches high and 21.5 inches wide. The cabin section flooring will withstand a loading of 200 pounds per square foot for items supported on the seat tracks. Floor areas where seat tracks are not present, walkways and aft baggage/utility area, will only support 100 pounds per square foot floor loads.

b. Standard Seating Arrangement. Seating is provided for eight passengers. The seats may be installed facing forward or aft. A side facing toilet is installed across from the cabin entrance door, separated from the passenger area by a partition. A seat belt is provided and seating one passenger is allowed in the toilet area. A baggage storage area is provided in the farthest aft portion of the cabin.

c. Ferry Fuel Configuration. The cabin area may be converted to accommodate ferry missions by removing the passenger seats and floor panels. The tank platforms and ferry tanks are secured with seat rail cargo rings on seat rails. The fuel tanks are connected to the provisions already installed in the fuel system.

6-12. PERSONNEL LOADING AND UNLOADING.

a. Seat Installation. The seats are mounted on full length seat tracks to provide for quick removal and reconfiguration of seats. The arm rests adjacent to the aisle may be lowered to allow ease of entry. The seats have reclining backs that may be adjusted for individual comfort. Each seat back must be in the full upright position for takeoff and landing.

b. Seat Belts and Shoulder Harnesses. The pilot's and copilot's seats are equipped with shoulder harnesses. The belt for the shoulder harness is in a Y configuration with a single strap contained in an inertia reel attached to the seat back. One strap is worn over each shoulder and fastened by metal loops to the seat belt buckle. Spring loading of the inertia reel allows normal movement. A locking device will secure the harness in the event of sudden forward movement or impact action. Some passenger seats are equipped with a lap seat belt and an over the shoulder restraining belt.

6-13. PERSONNEL LOAD COMPUTATION.

When aircraft are operated at critical gross weights, the exact weight of each individual occupant plus equipment should be used. If weighing facilities are not available, or if the tactical situation dictates otherwise, loads shall be computed as follows:

a. Combat Equipped Soldiers. Combat equipped soldiers shall be computed at 275 pounds per individual.

b. Crew and Passengers. Crew and passengers with no equipment shall be computed according to each individual's estimate.

Section V. MISSION EQUIPMENT

Not applicable.

Section VI. CARGO LOADING

6-14. AIR CARGO FEATURES.

The cabin area is easily converted for mixed or all cargo use, by removal of passenger seats and a partial partition. Refer to Figure 6-1. A top-hinged cargo door, with an opening of 52 inches wide by 52 inches high, is provided on the left side of the fuselage to admit bulk cargo. The floor is designed to support 200 pounds per square foot when supported by the seat tracks. The areas where seat track support is not possible will support 100 pounds per square foot floor loading. Seat tracks are to be used for securing cargo containers.

6-15. PREPARATION OF GENERAL CARGO.

Before loading cargo, loading personnel should determine such data as weight, dimensions, center of gravity, and contact areas of the individual cargo items for use in positioning the load.

6-16. CARGO CENTER OF GRAVITY PLANNING.

The cargo loading shall be planned so that the center of gravity of the loaded aircraft will fall within the operating limits shown on the Center of Gravity Loading Diagram. Refer to Figure 6-3. Cargo moment may be determined by using the Cargo Moment chart, Figure 6-4.

6-17. LOAD PLANNING.

The basic factors to be considered in any loading situation are as follows:

a. Cargo shall be arranged to permit access to all emergency equipment and exits during flight.

b. The cabin section flooring will withstand a loading of 200 pounds per square foot for items supported on the seat tracks. Floor areas where seat tracks are not present (walkways and aft baggage/utility area) will only support 100 pound per square foot floor loads. Shoring shall be used to distribute highly condensed weights evenly over the cargo areas. Use of the floor seat tracks to support loads is encouraged where possible.

c. All cargo shall be adequately secured to prevent damage to the aircraft, other cargo, or the item itself.

6-18. LOADING PROCEDURE.

NOTE

The cabin airstair door is weight limited to a maximum of 300 pounds to prevent possible structural damage.

Loading of cargo is accomplished through the cabin door (21.5 in. X 46.0 in.) or the cargo door (52 in. X 52 in.).

6-19. SECURING LOADS.

All cargo shall be secured with restraints strong enough to withstand the maximum force exerted in any direction. The maximum force can be determined by multiplying the weight of the cargo item by the applicable load factor. These established load factors (the ratio between the total force and the weight of the cargo item) are 1.5 to the side and rear, 3.0 up, 6.6 down, and 9.0 forward.

6-20. RESTRAINT DEVICES.

The aircraft is equipped with full-length seat tracks which are used to support the cargo and provide attachment points for the cargo tiedown devices. Refer to Figure 6-5. When cargo is properly secured by tiedown devices, it will be restrained from moving in any direction within the aircraft.

6-21. CARGO RESTRAINING METHOD.

CAUTION

To avoid structural damage, all cargo shall be restrained in accordance with Beech Kit Drawing No. 101-5040, which provides the correct methods for restraint and approved hardware.

Cargo is restrained by passing tiedown devices over and around the cargo and attaching the ends of the tiedown device to the seat tracks as shown in Figure 6-5. The number of tiedown devices required to restrain a given weight of cargo may vary.

6-22. CARGO UNLOADING.

Unloading of cargo shall be accomplished through the cabin door, or cargo door.

Section VII. CENTER OF GRAVITY

6-23. CENTER OF GRAVITY LIMITATIONS.

a. The forward Center of Gravity (CG) limit is 188.3 arm inches from 14,000 pounds to 13,500 pounds. From 13,500 pounds down to 11,279 pounds, the intermediate arm inch values vary linearly to 181 inches. Below 11,279 pounds, the maximum forward CG remains 181 arm inches.

b. The aft CG limit is 196.4 inches aft of datum at all weights. The Center of Gravity Loading Diagram is designed to establish forward and aft CG limitations.

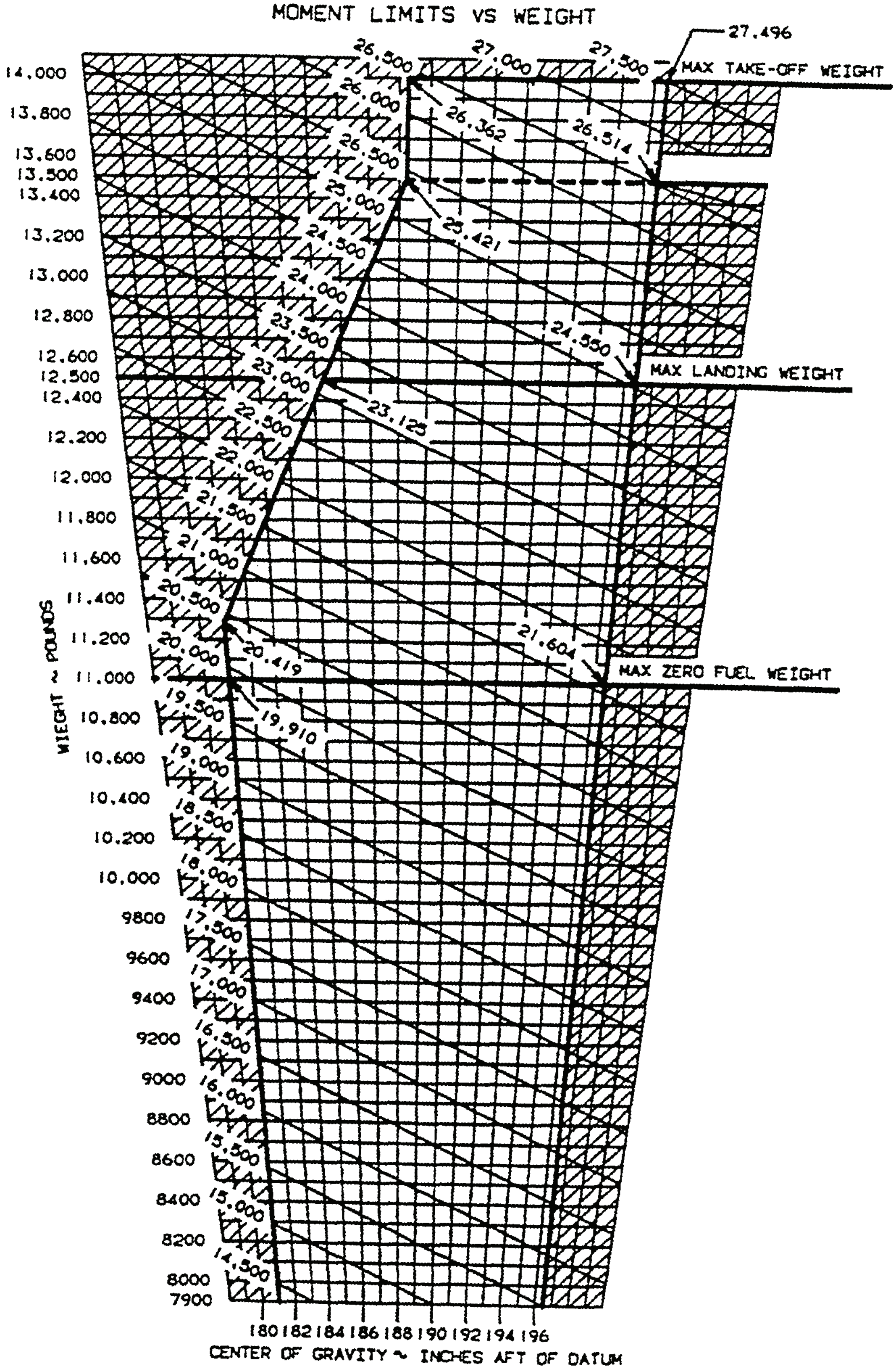


Figure 6-3. Center of Gravity Loading Diagram

WARNING

Operation of this aircraft, in the cargo configuration, with pilot and copilot only may exceed the forward CG limit. Add baggage and/or removable ballast in aft baggage compartment as required up to allowable maximum.

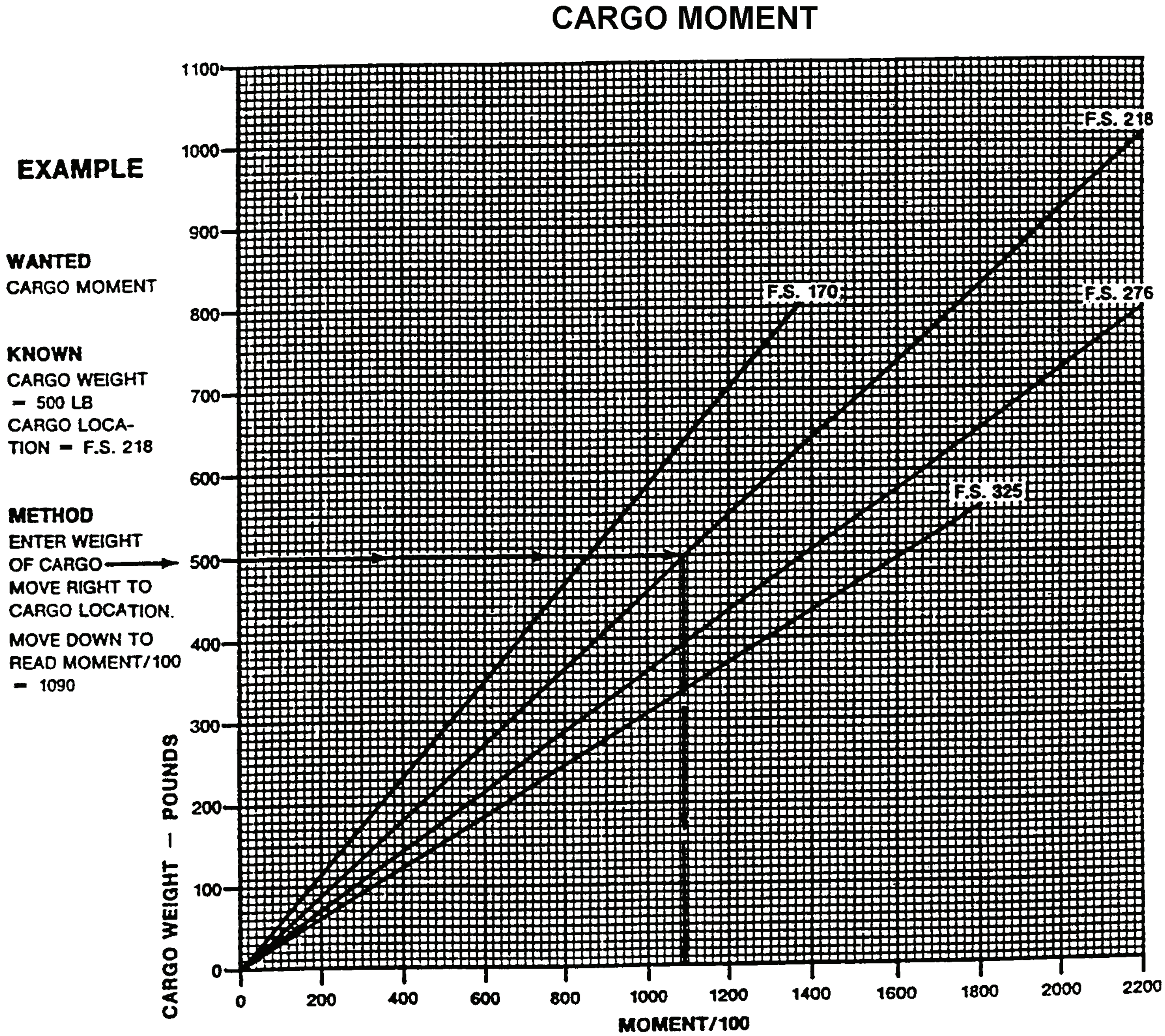


Figure 6-4. Cargo Moment Diagram

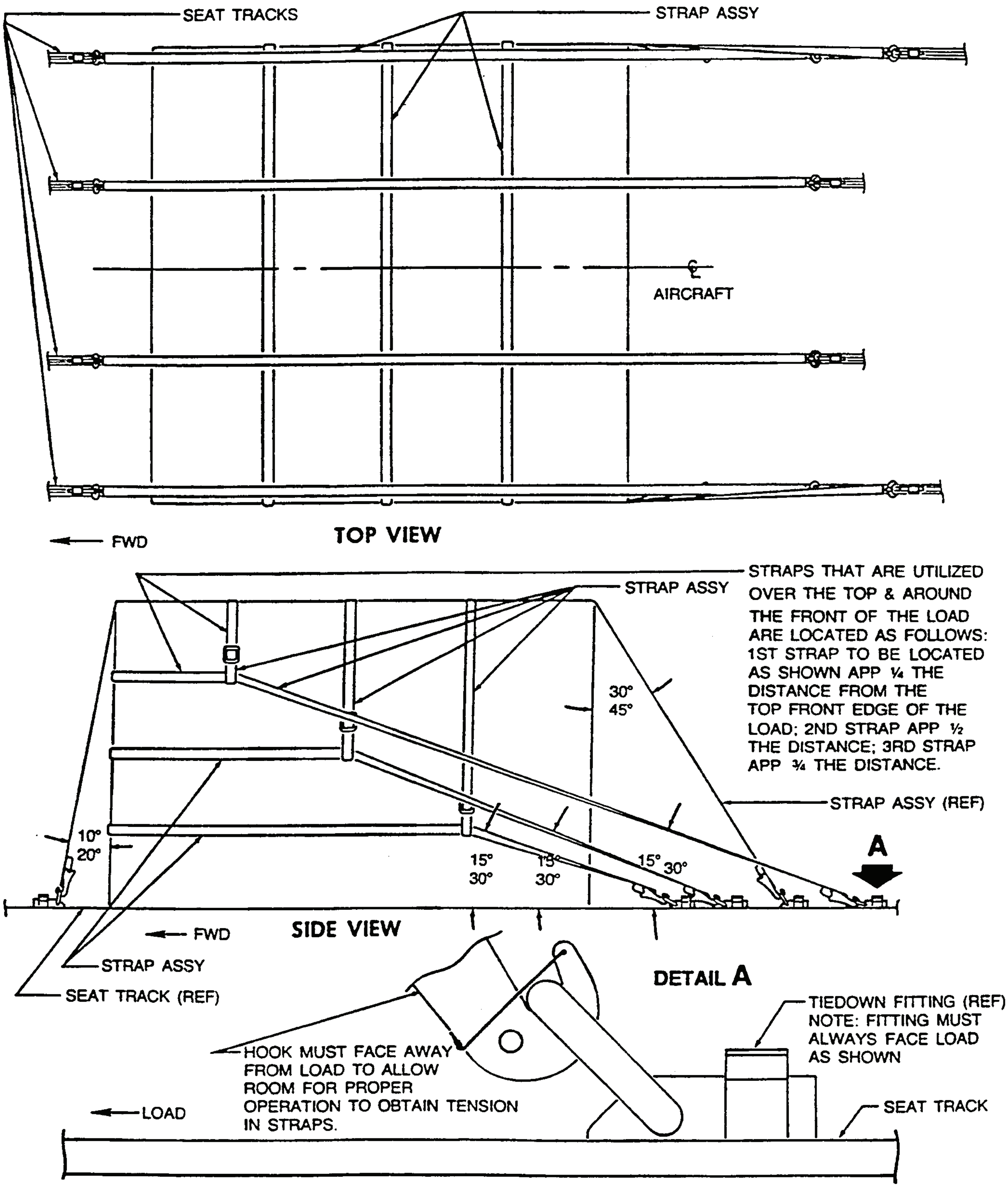


Figure 6-5. Cargo Restraint and Tiedown Method

CHAPTER 7
PERFORMANCE DATA

7-1. INTRODUCTION TO PERFORMANCE.

The graphs and tables in this chapter present performance information for takeoff, climb, landing, and flight planning at various parameters of weight, power, altitude, and temperature. Examples explaining appropriate use are provided for performance graphs.

7-2. HOW TO USE GRAPHS.

a. All airspeed and references to airspeeds in this chapter are indicated airspeeds unless otherwise noted.

b. A reference line indicates where to begin following the guidelines. Always project to the reference line first, then follow the guidelines to the next item by maintaining the same proportional distance between the guideline above and the guideline below the projected line. For instance, if the projected line intersects the reference line in the ratio of 30% down/70% up between the guidelines, then maintain this same 30%/70% relationship between the guidelines all the way to the next item.

c. The Airspeed Calibration - Normal System – Takeoff Ground Roll graph was used to obtain V_1 and V_r Indicated Airspeeds (IAS). All other indicated airspeeds were obtained by using the Airspeed Calibration - Normal System graph.

d. In addition to presenting the answer for a particular set of conditions, the example on a graph also presents the order in which the various scales on the graph should be used. For instance, if the first item in the example is Outside Air Temperature (OAT), then enter the graph at the known OAT. In some cases, performance planning may require entering the chart at one point in order to establish a baseline and then entering the chart at another point in order to obtain the answer. Follow the sequence of the example, or establish the necessary baseline and then follow the sequence of the example.

e. The associated conditions define the specific conditions from which performance parameters have been determined. They are not intended to be used as instructions; however, performance values determined from charts can be achieved only if the specified conditions exist.

f. Notes have been provided on various graphs and tables to approximate performance with ice vanes extended. The effect will vary, depending upon airspeed, temperature, altitude, and ambient conditions. At lower altitudes, where operation on the torque limit is possible, the effect of ice vane extension will be less, depending upon how much power can be recovered after the ice vanes have been extended.

7-3. EXAMPLES.

The following example presents the performance decision making process for correct flight planning and completion of the Takeoff and Landing Data (TOLD) card. Weather conditions for the departure and destination airports are given to illustrate the impact on performance planning and mission capabilities. The example mission is from Airport Alpha (AAA) to Airport Bravo (BBB). The en route distance is 700 nm. The planned cruise altitude is FL240.

a. Conditions. At Airport Alpha (AAA):

OAT . . . . 85°F (+30°C)

Field Elevation . . . . .3800 feet

Altimeter Setting. . . . . 29.72 in. Hg

Wind . . . . .330° at 10 knots

NOTE

Do not use headwinds for takeoff performance planning.

Runway 35 Length . . . . .6000 feet

Weather . . . . .400 feet overcast

Visibility . . . . .1 mile, rain/haze

b. Other Than Standard Takeoff Minimums and/or (Obstacle) Departure Procedures. At Airport Alpha:

Takeoff Minimums. . . . . Rwy 35, 500-2*

*Or standard with minimum climb of 250/NM to 5000′.

c. Mission. Transport the following load (personnel, baggage, and equipment) from Airport Alpha to Airport Bravo:

Personnel – 6

(1) 185 pounds	(1) 160 pounds
(1) 200 pounds	(1) 155 pounds
(1) 170 pounds	(1) 190 pounds

Subtotal pax……………….………1060 pounds

Baggage and Equipment –

(6) baggage @ 40 pounds	=	240 pounds
(1) 24″ x 24″ box	=	25 pounds
Subtotal baggage and equip	=	265 pounds

Total load…….…………………… …1325 pounds

d. Performance Planning (Back of TOLD Card). Refer to Figure 7-1. The back side of the TOLD card is a takeoff weight worksheet. It is designed to assist the crew in the decision making process as to maximum allowable takeoff weight for the conditions and the takeoff configuration. The instructions herein are consistent with TC 1-218, Aircrew Training Manual (ATM). Complete the card as follows:

(1) Field Length Available is 6,000 feet.

NOTE

If the runway has an approved runway overrun, that distance may be added to the runway length for Accelerate/Stop calculations.

(2) Temperature (forecast for time of departure) is +30 °C.

(3) Pressure Altitude (PA). To determine the PA, add 1000 feet to field elevation for each 1.00 in. Hg that the reported altimeter setting value is below 29.92 in. Hg, and subtract 1000 feet for each 1.00 in. Hg above 29.92 in. Hg. First, find the difference between 29.92 in. Hg and the reported altimeter setting. Then, multiply the answer by 1000 to find the difference in feet between field elevation and pressure altitude. PA is inversely proportional to barometric pressure, as the barometric pressure decreases the PA increases and as the barometric pressure increases, the PA decreases.

Pressure Altitude at AAA:

29.92 in. Hg - 29.72 in. Hg = 0.20

0.20 X 1000 feet = 200 feet

Because the barometric pressure is lower than ISA, the PA will be higher than field elevation. The pressure altitude at AAA is 200 feet above field elevation.

Pressure Altitude at AAA = Field Elevation 3800 feet + 200 feet = 4000 feet.

(4) Takeoff Configuration, Flaps 0% or 40%, will be determined by the crew after completing this side of the TOLD card.

Takeoff Weight Worksheet

FIELD LENGTH AVAILABLE: (1)		
TEMP. °C: (2)	**P.A.:** (3)	
TAKEOFF CONFIGURATION: (4) FLAPS	**UP**	**40%**
Max Wt to Achieve SE Climb	(5)	(6)
Max Wt For ACC/STOP	(7)	(8)
***Max Wt For Req. SE CLB GRAD** (Min 3.3%)	(9)	
Max Allow Takeoff Weight	________(10)______.	

***SE Climb Conversion:**

$$\frac{\text{Ft. per nm}}{\text{6,076'}} \times 100 = \_\_\_\_\_\%$$

DA FORM 4888-R (Back) **C-12 TOLD**

Figure 7-1. TOLD Card (Back)

(5) and *(6)* Maximum weight allowable to achieve a single engine climb, flaps 0% and 40%. Refer to Figures 7-15 and 7-16, Takeoff Weight to Achieve Positive One Engine Inoperative Climb at Liftoff, Flaps **UP** and Flaps **APPROACH**.

Enter each of the graphs at the pressure altitude of 4000 ft., trace to the right until intersecting the correct temperature line, +30 °C, then trace down vertically and read the maximum allowable takeoff weight for these conditions. For Flaps **UP** it is 14,000 pounds. For Flaps **APPROACH** it is 12,750 pounds. Enter those takeoff weight limitations in the appropriate blocks of the TOLD card.

(7) and *(8)* Maximum Weight to accomplish Accelerate and Stop distance, flaps 0% and 40%. Refer to Figures 7-22 and 7-26, Accelerate – Stop, Flaps **UP** and Flaps **APPROACH**.

Enter each of the graphs on the right vertical scale, ACCELERATE-STOP FIELD LENGTH ~ FEET, at the field length available. In this example there is no runway overrun, therefore the field length available is the runway length of 6000 feet. Mark that line as a baseline, it becomes the limit for maximum allowable takeoff weight.

Enter the left side of the graph at the OUTSIDE AIR TEMPERATURE ~ °C at the forecast temperature of +30°. Trace up vertically until intersecting the correct PRESSURE ALTITUDE ~ FEET line, 4000 feet. Trace to the right until intersecting the first REFERENCE LINE. Because the point on the REFERENCE LINE for Flaps **UP** is above the 6000 feet runway length, maintain the same relative distance between the guidelines and trace down until intersecting the 6000 feet field length line. From that point, trace down vertically to read the maximum allowable takeoff weight that will allow accomplishment of an acceleration to V_1 and stop. The maximum allowable takeoff weight is 12,800 pounds.

Using Figure 7-26, utilize the chart in the same manner. In this, case the point on the REFERENCE LINE for Flaps **APPROACH** is below the 6000 feet field length line, the accelerate-stop distance is 5,100 feet and accelerate – stop can be accomplished at 14,000 pounds.

For Flaps **UP** the maximum takeoff weight to achieve Accel/Stop is 12,800 pounds. For Flaps **APPROACH** it is 14,000 pounds. Enter those takeoff weight limitations in the appropriate blocks of the TOLD card.

(9) Maximum Weight Allowable To Accomplish the Required Single Engine Climb Gradient. Refer to Figure 7-31 Climb – One Engine Inoperative.

A 3.3% single engine climb gradient is required for all IFR takeoffs. In the absence of any Departure Procedure (DP) or other requirement, the 3.3% climb gradient line is the baseline for determining the maximum allowable takeoff weight in order to achieve that single engine climb gradient.

In this example, the weather forecast for the time of departure is 400 feet overcast and 1 mile visibility with rain and haze. The non-standard takeoff minimums for Airport A are 500 foot ceiling and 2 miles visibility. However, the departure may be accomplished using standard AR 95-1 takeoff minimums if a single engine climb gradient of 250 feet per nm can be achieved. Therefore, the maximum allowable takeoff weight to achieve a single engine climb gradient of 250 feet per nm must be determined.

In Figure 7-31, to use the CLIMB GRADIENT ~ % scale, the required gradient of 250 feet per nautical mile must be converted to a percentage. The method is included in the Climb Conversion portion of the TOLD card. The feet per nautical mile are divided by 6076 (the number of feet in a nautical mile) and multiplied by 100, yielding the climb gradient in percent.

For this example divide 250 feet per nautical mile by 6076, then multiply by 100 in order to convert to a percentage.

$250 \div 6076 \times 100 = 4.1\%$

From the CLIMB GRADIENT ~ % scale trace horizontally from 4.1% to the left onto the graph in order to establish the baseline limit for maximum takeoff weight in order to achieve the required single engine climb gradient of 4.1%.

Now, enter the graph at the OUTSIDE AIR TEMPERATURE ~ °C scale at +30 °C. Trace up until intersecting the 4000 feet PA line, trace horizontally to the right until intersecting the REFERENCE LINE. Because the intersecting point on the reference line is below the 4.1% baseline, maintain the same relative distance between the guidelines and trace up until intersecting the 4.1% baseline. From that point, trace down to read the maximum allowable takeoff weight in order to achieve a single engine climb gradient of 4.1%.

The maximum allowable takeoff weight to achieve a 4.1% single engine climb gradient is 12,600 pounds. Enter that weight in the appropriate block on the TOLD card.

(10) Maximum Allowable Takeoff Weight. Enter the most restrictive weight from each column, including the **Max Wt For Req. SE CLB GRAD** block, in the appropriate space on the TOLD card. For Flaps **UP** the weight is 12,600 pounds. Climb, one engine inop is the most restrictive weight for this departure.

e. Completed TOLD (Back) and Decision Making. Refer to Figure 7-2. The completed back side of the TOLD card is now used for determining the takeoff configuration (Flaps 0% or 40%) and the fuel load in order to maintain the aircraft at the maximum allowable weight for all of the conditions.

(1) For this example, the takeoff can be accomplished at an aircraft weight of 12,600 pounds with the flaps **UP** or at **APPROACH**. This takeoff is planned with Flaps **UP** at 12,600 pounds.

For this example, the aircraft Operating Weight is 9,300 pounds and the Load for the mission is 1,325 pounds therefore, the Zero Fuel Weight (Operating Weight plus the Load) is 10,625 pounds. The takeoff weight of 12,600 pounds minus the zero fuel weight of 10,625 pounds allows for 1,975 pounds of fuel for the mission.

(2) Transfer the pertinent information to the front side of the TOLD card and complete it for the departure.

f. Performance Planning (Front of TOLD Card). Refer to Figure 7-3. The front side of the TOLD card is used to record the critical information for conduct of the takeoff and, in the event of an emergency during the takeoff, landing data for an immediate return to the departure airport. The instructions here are consistent with the ATM. Complete the front side of the card as follows:

(1) thru *(5)* were determined on the back side of the card and transposed to these blocks.

(6) Minimum Takeoff Power. Use Figure 7-17, Minimum Takeoff Power at 2000 RPM with Ice Vanes Retracted (65 Knots) or Figure 7-18, Minimum Takeoff Power with Ice Vanes Extended (65 Knots).

Takeoff Weight Worksheet

FIELD LENGTH AVAILABLE: *6,000 ft.*

TEMP. C°: *+30°C* **P.A.:** *4,000 ft.*

TAKEOFF CONFIGURATION: (4)

FLAPS

	UP	40%
Max Wt to Achieve SE Climb	*14,000*	*12,750*
Max Wt For ACC/STOP	*12,800*	*14,000*
***Max Wt For Req. SE CLB GRAD** (Min 3.3%) *4.1%*	*12,600*	
Max Allow Takeoff Weight	*12,600*	*12,600*

***SE Climb Conversion:**

$$\frac{250 \text{ Ft. per nm}}{6{,}076'} \times 100 = 4.11\%$$

DA FORM 4888-R **C-12 TOLD (Back)**

Figure 7-2. TOLD Card Back (Example Completed)

TAKEOFF and LANDING DATA (TOLD)	
TAKEOFF	
Station: (1)	**Field Lgth Avail:** (2)
Temp °C: (3)	**P.A.:** (4)
Takeoff Weight: (5)	
Min. Takeoff Power: ___(6)___.	
Configuration: (7) **Flaps 0%**___**Flaps 40%**___.	
T.O. Fld. Lgth Req'd: ___(8)___.	
ACC/GO Distance: ___(9)___.	
V_1 / V_r ___(10)___. **V_2 / V_{yse}** ___(11)___ **Vx** ___(11a)___.	
Clb. Grd. Alt. ___(12)___.	
LANDING	
Rwy Lgth Available: ___(13)___.	
Landing Weight: ___(14)___.	
V_{ref} ___(15)___.	**V_{app}** ___(16)___.
Flaps 100% (1.3 X V_{so} @ Ldg. Wt.)	Inst. App. = V_{ref} + 20 KIAS
Flaps 40% to 99%+(1.3 X V_{s1} @ Ldg. Wt.)	Stabilized = V_{ref} + 10 KIAS Visual App = V_{ref} + 10 KIAS
LANDING DISTANCE ___(17)___.	
DA FORM 4888-R	**C-12 Takeoff and Landing Data**

Figure 7-3. TOLD Card (Front)

Enter the appropriate graph at the OUTSIDE AIR TEMPERATURE ~ °C. From +30 °C trace up until intersecting the correct PRESSURE ALTITUDE – FEET line, 4000 feet. Trace horizontally to the left until intersecting the ENGINE TORQUE AT 2000 RPM ~ PERCENT scale and read the Minimum Takeoff power.

In this example the minimum takeoff power is 90.2%. Enter the information on the TOLD card.

NOTE

Performance planning methodology and operational procedures for Minimum Takeoff Power takeoffs and Reduced Power takeoffs are contained in the ATM.

(7) Configuration. Mark (✓ or X) the appropriate configuration as determined on the back of the TOLD card. For this example, it was decided to takeoff with the Flaps **UP**.

(8) Takeoff Field Length Required. For this example, enter the actual ACC/STOP distance of 5,900 feet for a 12,600-pound aircraft.

If the weight to accomplish an ACC/STOP had been the most restrictive weight, then we would enter the field length that was used on the back of the TOLD card to determine the maximum takeoff weight to achieve an acceleration and stop maneuver (6000 feet).

(9) Accelerate – Go Distance. This distance is advisory only. Use Figure 7-23. Accelerate – Go, Flaps **UP** or Figure 7-27, Accelerate – Go, Flaps **APPROACH**.

Enter the graph at the OUTSIDE AIR TEMPERATURE ~ ºC, +30 ºC. Trace up until intersecting the correct PRESSURE ALTITUDE ~ FEET line, 4000 feet. Trace horizontally to the right until intersecting the REFERENCE LINE. Maintain the same relative distance between the guidelines and trace up until intersecting the aircraft takeoff WEIGHT ~ POUNDS line. Trace horizontally to the right and read the accelerate – go distance.

In this example, the takeoff weight is planned at 12,600 pounds. The accelerate – go distance is 8,800 feet.

Enter the distance, 8,800 feet, in the appropriate block on the TOLD card.

As already stated, Accelerate-Go distance is advisory only. However, a point 35 feet above the end of the departure runway is normally the point from which climb gradients are calculated. Therefore, regardless of all other prudent performance planning, if an engine fails at V_1 on this example departure the aircraft will not be capable of clearing all obstacles. If weather conditions are at or near minimums, the crew should consider some other options to assure the capability to accomplish an acceleration and go maneuver such as:

Decreasing the load and/or fuel.

Reducing takeoff weight and using flaps 40%.

Delaying the departure for more favorable weather conditions.

(10) V_1 (Takeoff Decision Speed) / V_r (Rotation Speed). In the C-12 aircraft V_1 and V_r are always the

same speed. Use the tabular data table at the top of Figure 7-21, Take-Off Distance, Flaps **UP** or Figure 7-25, Take-Off Distance, Flaps **APPROACH**.

The takeoff configuration for this example is Flaps **UP**. The V_1/V_r speed is 112 KIAS.

Enter the speed, 112 KIAS, in the appropriate block on the TOLD card.

(11) V_2 / V_{yse}. Use the tabular data table at the top of Figure 7-31, Climb – One Engine Inoperative. In accordance with the ATM, flaps are retracted just after liftoff at 105 KIAS for both a normal takeoff and in the event of an engine failure after V_1. The CLIMB SPEED V_2 - KNOTS, Figure 7-31, is V_{yse} and is essentially the same speed as V_2 for a takeoff with flaps at 0%. Consequently, V_2 flaps 0% and V_{yse} are used as the V_2 speed for entry on the TOLD card. V_2 / V_{yse} for a 12,600 pound aircraft is 122 KIAS.

Enter the speed in the appropriate block on the TOLD card.

(11A) If conducting an obstacle clearance climb, use the “Vx” speed from the TAKEOFF DISTANCE – FLAPS APPROACH chart.

(12) Climb Gradient Altitude. This is the altitude to which the single engine climb gradient must be continued as specified in the applicable DP. The information is advisory and intended as a reminder to the crew of the altitude to which they must climb at V_2 / V_{yse} in order to clear obstacles.

For this example, the DP specified climbing to 5000 feet MSL.

Enter the altitude, 5000 feet, in the appropriate block on the TOLD card.

NOTE

Items 13 through 17 are initially calculated at takeoff weight as a contingency for a necessary return to the takeoff airport right after departure. The items must be re-calculated for the arrival at the destination.

(13) Runway Length Available. This is the runway length available for landing.

For this example, the runway length is 6000 feet and there is no displaced threshold or other information limiting the useful landing distance of the runway.

Enter the length, 6000 feet, in the appropriate block on the TOLD card.

(14) Landing Weight. For the takeoff TOLD card, landing and takeoff weights are the same. For arrival at the destination the TOLD card must be re-calculated to reflect actual aircraft weight and airport conditions.

For this example, takeoff and landing weight is 12,600 pounds.

Enter the weight, 12,600 pounds, in the appropriate block on the TOLD card.

(15) V_{ref} Speed. This speed is 1.3 times V_{so} at the intended landing weight if the landing will be accomplished using Flaps **DN**. If the landing will be accomplished with the Flaps at **APPROACH**, or any setting greater than **APPROACH** but less than **DOWN**, then V_{ref} is 1.3 times V_{s1} (the stall speed for FLAPS **APPROACH**). Use Figure 7-13, Stall Speeds – Power Idle to determine applicable stall speeds.

For this example, the landing weight (assuming an emergency return to the departure airport) is 12,600 pounds a landing with the Flaps **DOWN** is planned. The V_{so} for a 12,600-pound aircraft is 75 KIAS. Therefore, V_{ref} is 1.3 times 75 = 97.5 and is rounded up to 98 KIAS.

There is another method to determine V_{ref} when the landing will be accomplished with the Flaps **DOWN**. Subtract 5 KIAS from the APPROACH SPEED ~ KNOTS obtained from the tabular data table at the top of Figure 7-107, Landing Distance Without Propeller Reversing, Flaps **DOWN**. For a 12,600-pound aircraft, the given APPROACH SPEED is 103 KIAS – 5 KIAS = 98 KIAS.

NOTE

If the aircraft will be landed with FLAPS less than full DOWN, the LANDING DISTANCE- FLAPS UP (Figure 7-108 or 7-110) must be used to obtain the landing distance for the TOLD card

As another example, if the landing was planned using the Flaps at **APPROACH**, or any intermediate setting short of **DOWN**, then the V_{ref} speed would be 1.3 times V_{s1} (the FLAPS APPROACH stall speed). FLAPS APPROACH stall speed for a 12,600 pound aircraft is 85 KIAS. Therefore, the V_{ref} speed is 1.3 times 85 = 110.5 and is rounded up to 111 KIAS.

For this example with Flaps **DOWN** enter the V_{ref} speed, 98 KIAS at the appropriate place on the TOLD card. Refer to Figure 7-4 for an example of a completed TOLD card front.

TAKEOFF and LANDING DATA (TOLD)	
TAKEOFF	
Station: *AAA*	**Field Lgth Avail:** *6000 ft*
Temp C°: *+30 °C*	**P.A.:** *4000 ft*
Takeoff Weight: *12,600*	
Min. Takeoff Power: *90.2%* (7)	
Configuration: Flaps 0% *X* **Flaps 40%** ___	
T.O. Fld. Lgth Req'd: *5900 ft*	
ACC/GO Distance: *8800 ft*	
V1 / Vr *112* . **V2 / Vyse** *122* . **Vx** ___	
Clb. Grd. Alt. *5000 ft*	
LANDING	
Rwy Lgth Available: *6000 ft*	
Landing Weight: *12,600*	
V_{ref} *98*	**V_{app}** *118*
Flaps 100% (1.3 X V_{so} @ Ldg. Wt.)	Inst. App. = V_{ref} +20 KIAS
Flaps 40% to 99%+(1.3 X V_{s1}@ Ldg. Wt.)	Stabilized = V_{ref} +10 KIAS Visual App = V_{ref}+10 KIAS
LANDING DISTANCE *2000 ft*	
DA FORM 4888-R	**C-12 Takeoff and Landing Data**

Figure 7-4. Example TOLD Card (Front)

(16) V_{app} Speed. This is the intended final approach speed. It is V_{ref} plus 20 KIAS for a normal instrument approach; V_{ref} plus 10 KIAS for a stabilized approach; and, V_{ref} to V_{ref} plus 10 KIAS for a visual approach as determined by the PC.

For this example, the landing is planned with the Flaps **DOWN** so the V_{ref} is 98 KIAS. The weather conditions are such that a normal instrument approach back into the departure airport is planned in the event of a takeoff emergency. Therefore, the V_{app} will be V_{ref} plus 20 KIAS.

V_{ref} is 98 KIAS + 20 KIAS = V_{app} 118 KIAS. Enter this speed in the appropriate block on the TOLD card.

(17) Landing Distance. The distance, measured from the landing touchdown, required to land the aircraft and stop. Use Figure 7-107, Landing Distance Without Propeller Reversing - Flaps **DOWN**.

NOTE

Do not use a headwind or headwind component in calculating landing distance. But, if a downwind landing is required, then ensure the tailwind is factored.

Enter the chart at the OUTSIDE AIR TEMPERATURE ~ ºC, +30 ºC. Trace up until intersecting the correct PRESSURE ALTITUDE ~ FEET line, 4000 feet. Trace horizontally to the right until intersecting the first REFERENCE LINE. Maintain the same relative position between the guidelines and trace down until intersecting the aircraft weight line. From that point, trace horizontally to the DISTANCE ~ FEET scale to determine the landing distance.

For this example, the landing weight is 12,600 pounds. Assuming a takeoff emergency, the landing weight may exceed the landing weight limit of 12,500 pounds.

The landing distance is 2,000 feet.

Enter that number, 2,000 feet, in the appropriate block of the TOLD card. Remember, if the landing is planned for touchdown to be at the 1000-foot markers, then 3,000 feet will be required to accomplish this landing with full flaps.

g. Performance Planning, Cruise. Recommended Cruise Power, 1700 RPM charts beginning at Figure 7-34 are normally used for cruise performance planning. Use Figure 7-11, ISA Conversion, to determine the correct chart, relative to ISA, for cruise performance planning. For this example, the mission is planned to be flown at FL240.

(1) If a weather forecast provides the forecast temperature at the cruise altitude, enter Figure 7-11 at that temperature. Trace up until intersecting the planned PRESSURE ALTITUDE ~ FEET. At that point, determine the closest ISA +/- guideline and use the corresponding chart for planning.

If the forecast temperature for FL 240 is –10 ºC, enter the chart at that temperature. Trace up until intersecting the 24,000 feet reference line. Note which reference line is closest and use the corresponding chart for planning. If the point is exactly midway between two reference lines, use the reference line to the right of the point.

In this example, the point is between ISA + 20 and ISA + 30, and is closest to ISA + 20. Therefore, use Figure 7-39. Normal Cruise Power, 1700 RPM - ISA +20 ºC for cruise performance planning.

Enter the chart at 24,000 feet pressure altitude and read across horizontally to determine cruise torque, fuel flow, and airspeeds.

(2) If a weather forecast does not include a temperature at the cruise altitude, then the temperature must be calculated using a standard lapse rate and the temperature at the departure airport.

In this example, the temperature at the departure airport is +30 ºC. The pressure altitude is 4000 feet and the ISA temperature at that pressure altitude would be +7 ºC.

Temperature decreases at 2 ºC per thousand feet; 4000 feet ÷ 1000 feet = 4; 4 x 2 ºC = 8 ºC decrease in temperature. Therefore, ISA at 4000 feet PA is +15 ºC (SL ISA) – 8 ºC = +7 ºC.

The actual surface temperature of +30 ºC at Airport A, PA 4000 feet, is 23º above ISA (+7 ºC). Therefore, it is ISA +23 at the airport. If it is ISA +23º at the departure surface and a standard lapse rate of 2º per thousand feet of increased altitude is used, then it will be ISA +23º at the planned cruise altitude.

On Figure 7-11, ISA +23º is closest to the ISA + 20 reference line; therefore, use Figure 7-39, Normal Cruise Power, 1700 RPM, - ISA +20 ºC for cruise performance planning.

(3) The following planning data is derived from the Figure 7-39, Normal Cruise Power, 1700 RPM - ISA +20 ºC cruise chart for this example:

Torque per engine – 75%

Fuel flow per engine – 291 pounds/hour

Total fuel flow – 582 pounds/hour

IAS (12,000 pounds) – 179 KIAS

TAS (12,000 pounds) – 271 KTAS

The above data is used for the corresponding entries on the DD Form 175 and for flight planning.

As a general rule, the total fuel flow from the Recommended Cruise charts will sufficiently match the results of a more detailed fuel planning process using: time, fuel, and distance to climb; cruise fuel; and, time, fuel, and distance to descend. Therefore, for mission planning purposes, the total fuel flow from the appropriate cruise chart will suffice. Therefore, for this example, the total fuel in hours and minutes for entry on the DD Form 175 is 3+24 hours.

Fuel for the mission 1975 pounds
÷ fuel flow per hour 582 pounds
= 3.39 hours (3+24)

The minimum reserve fuel for the mission is 437 pounds.

Fuel flow per hour 582 pounds
x 45 minutes, .75
= 436.5 (437 pounds)

Fuel available for the mission minus required reserve is 1538 pounds.

Total mission fuel 1975 pounds
- reserve fuel 437 pounds
= 1538 pounds

Mission endurance fuel, minus reserves, is.

Mission fuel minus reserve 1538 pounds
÷ fuel flow per hour 582 pounds
= 2.64 hours (2 + 37)

AIRSPEED CALIBRATION – NORMAL SYSTEM

TAKE-OFF GROUND ROLL

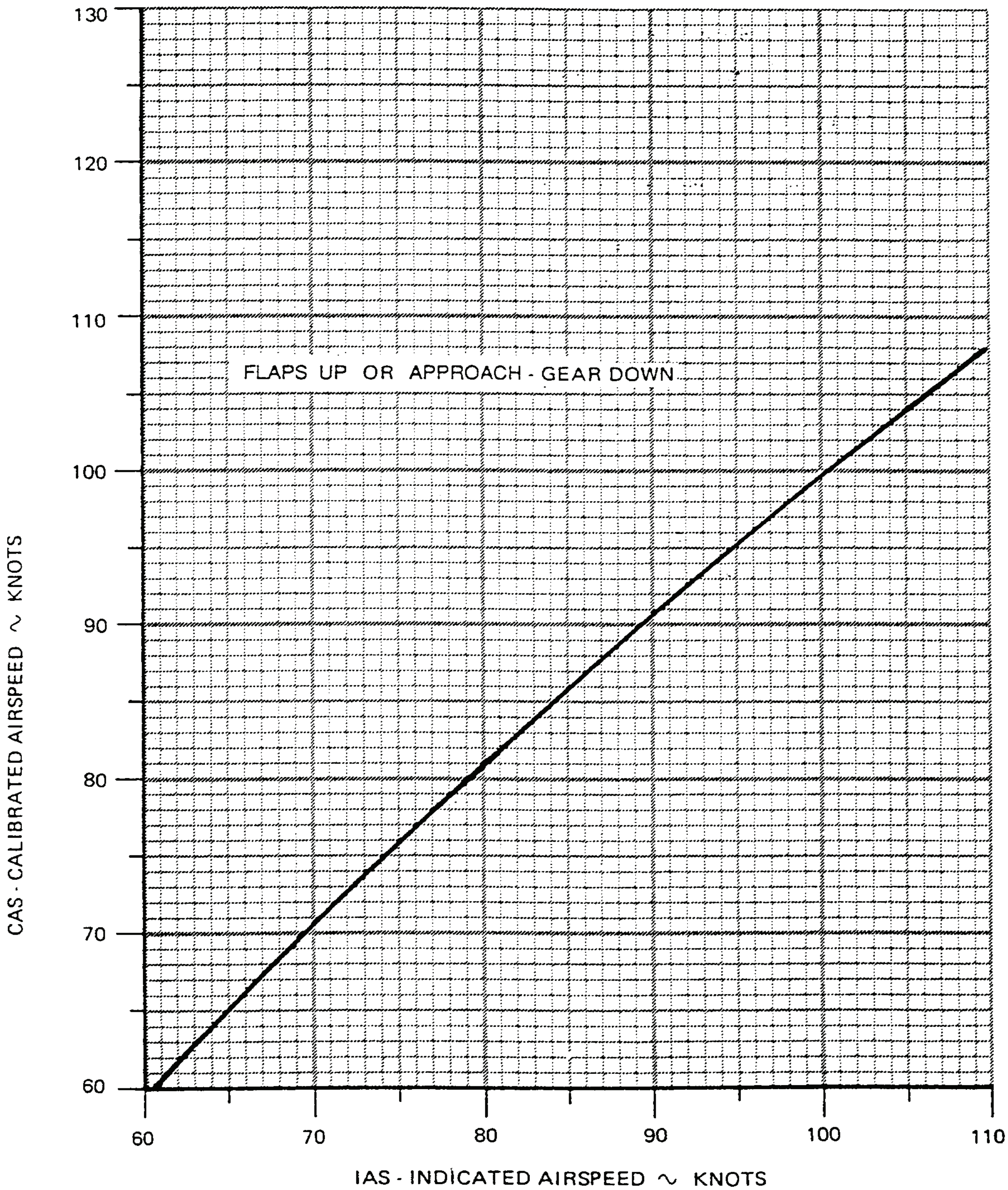


Figure 7-5. Airspeed Calibration – Normal System, Takeoff Ground Roll

AIRSPEED CALIBRATION – NORMAL SYSTEM

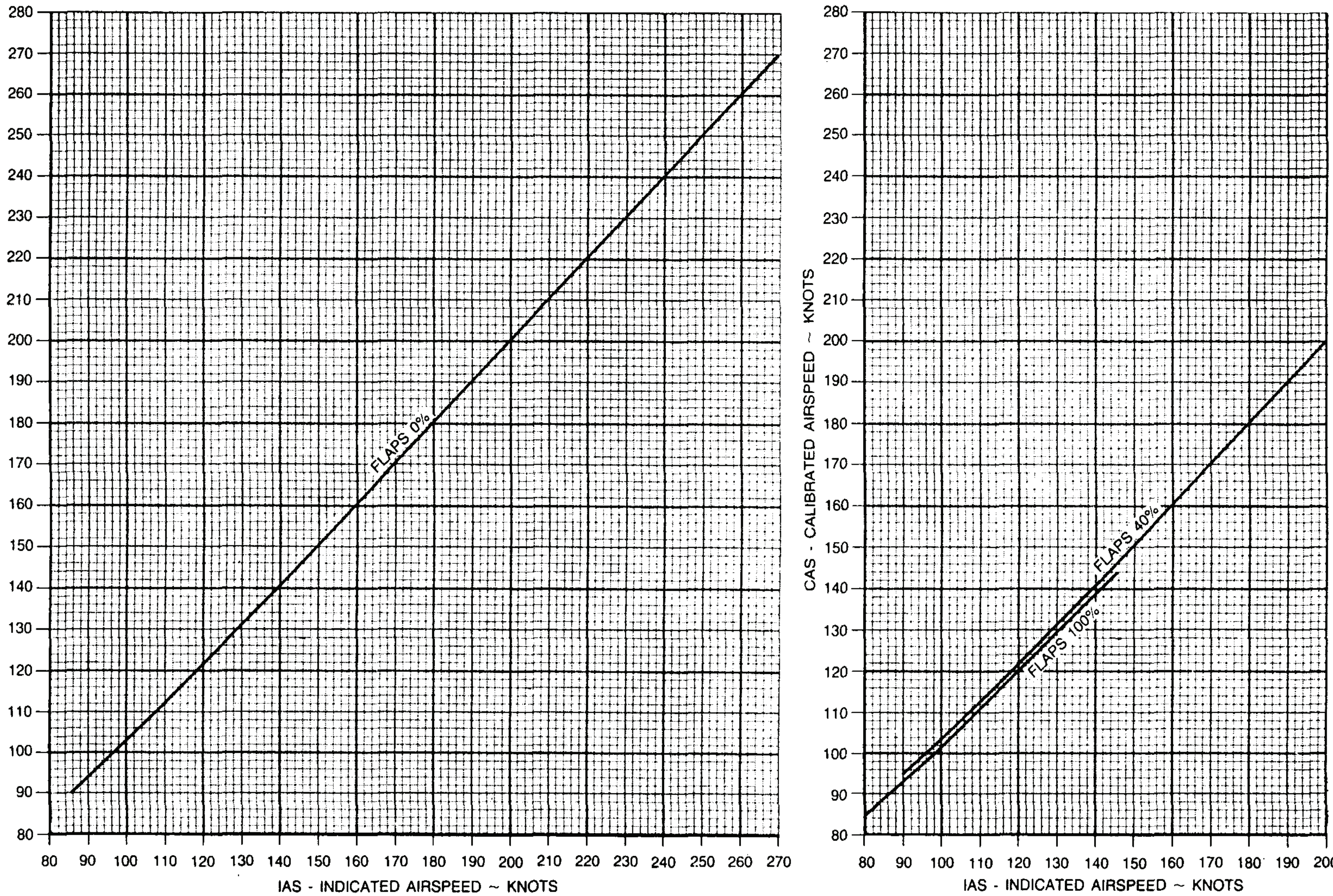


Figure 7-6. Airspeed Calibration – Normal System

ALTIMETER CORRECTION – NORMAL SYSTEM

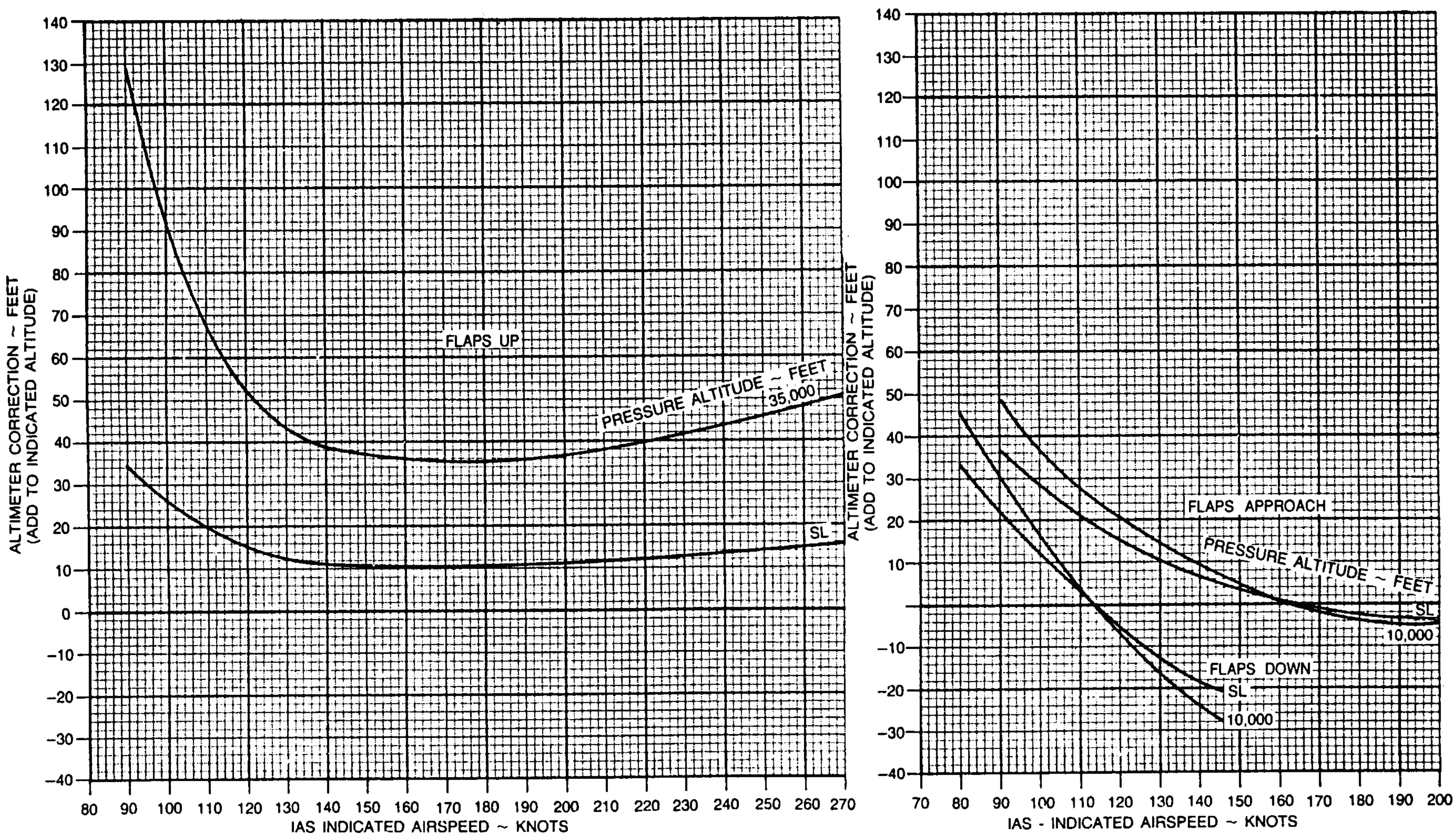


Figure 7-7. Normal System

AIRSPEED CALIBRATION — ALTERNATE SYSTEM

APPLICABLE FOR ALL FLAP POSITIONS

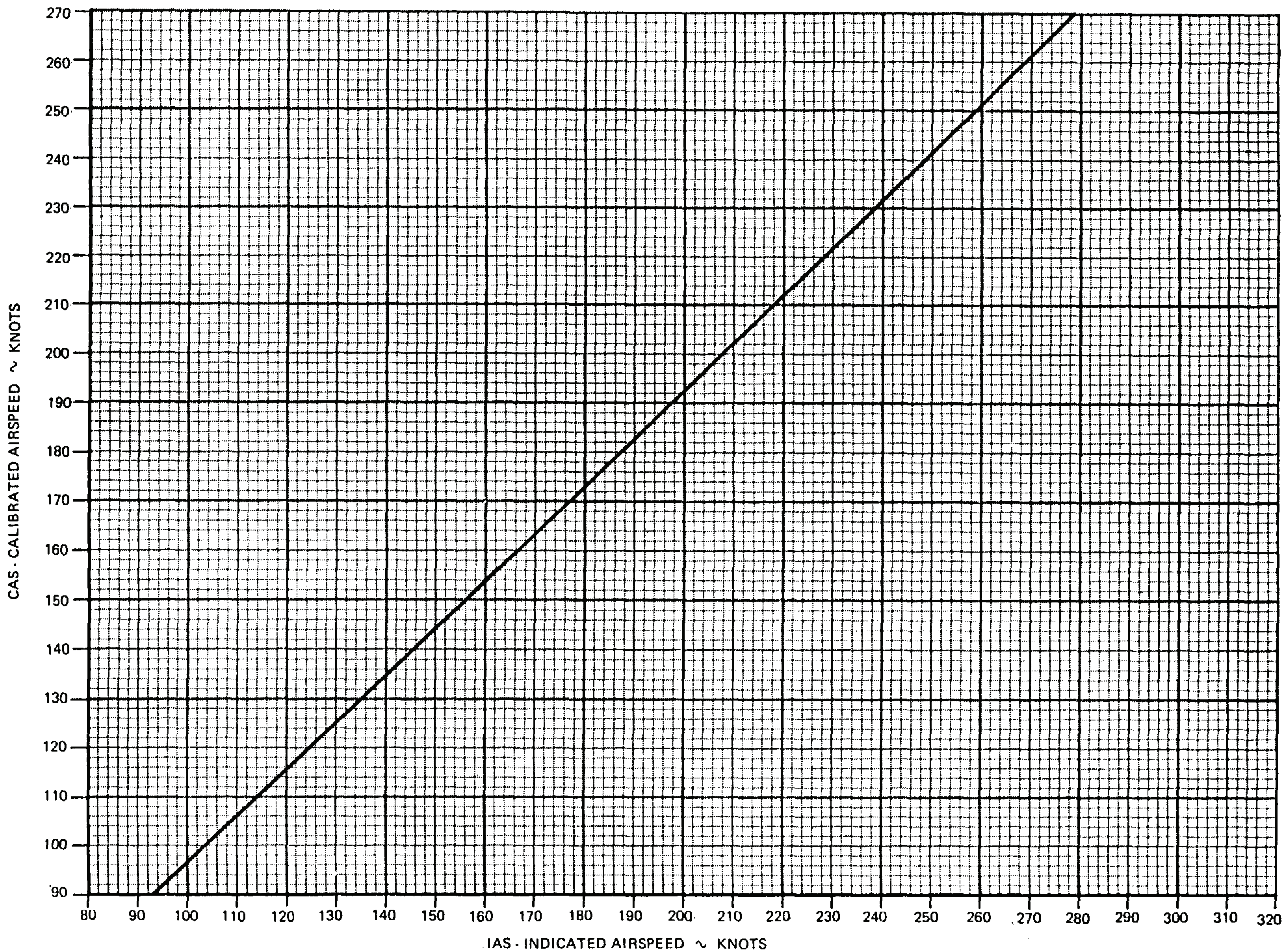


Figure 7-8. Airspeed Calibration – Alternate System

ALTIMETER CORRECTION – ALTERNATE SYSTEM

APPLICABLE FOR ALL FLAP POSITIONS

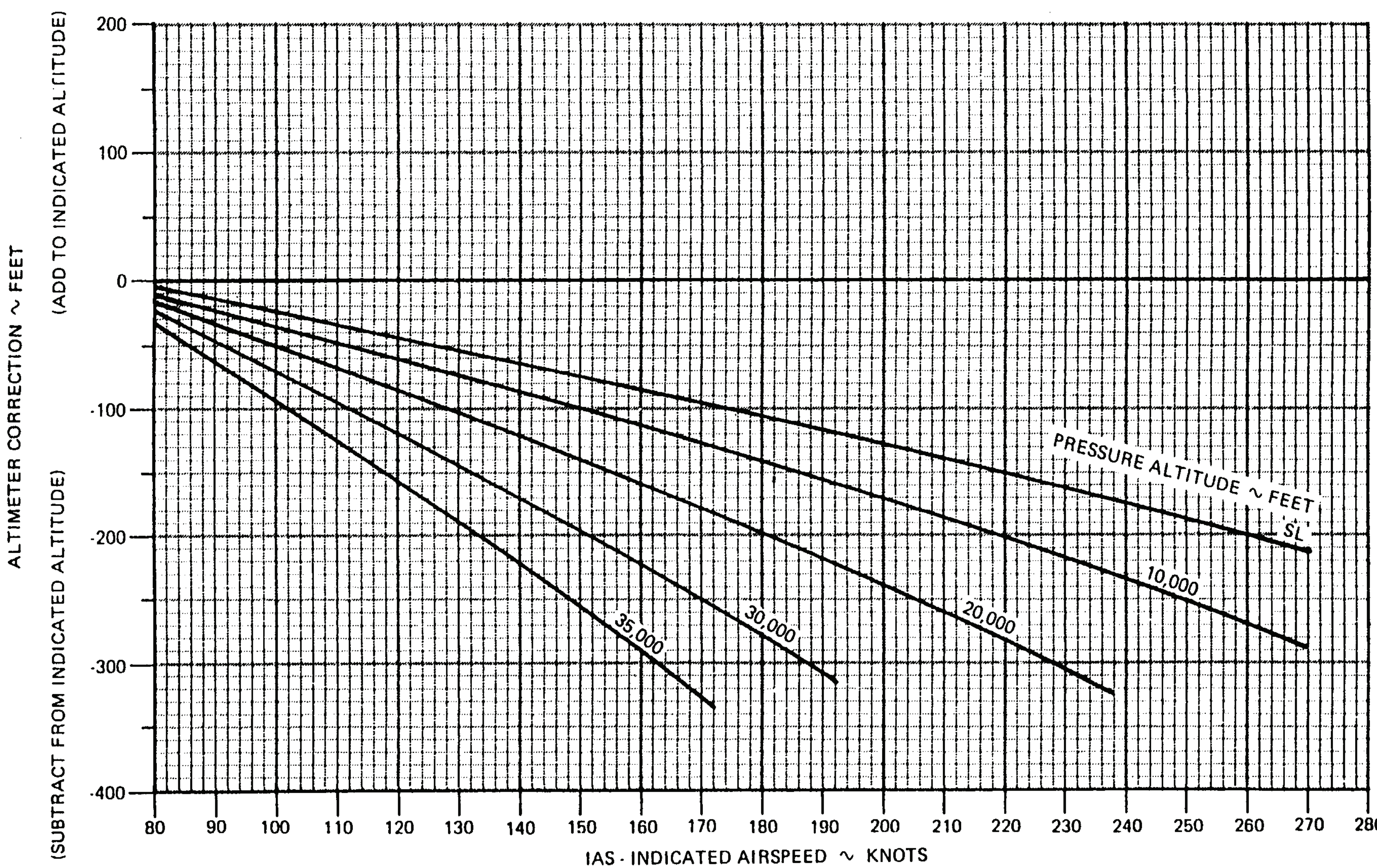


Figure 7-9. Altimeter Correction – Alternate System

INDICATED OUTSIDE AIR TEMPERATURE CORRECTION

STANDARD DAY (ISA)

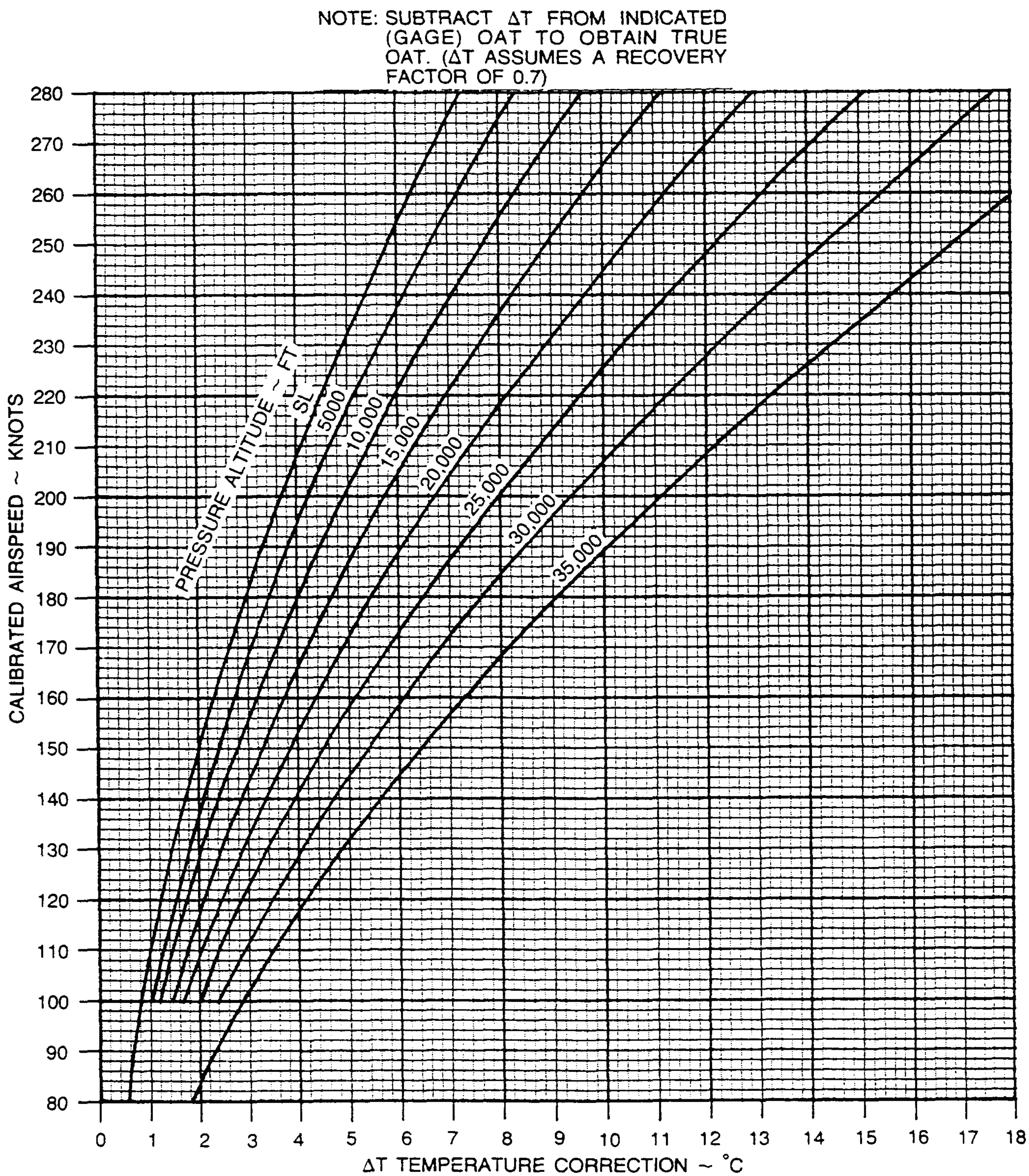


Figure 7-10. Indicated Outside Air Temperature Correction – ISA

ISA CONVERSION

PRESSURE ALTITUDE vs OUTSIDE AIR TEMPERATURE

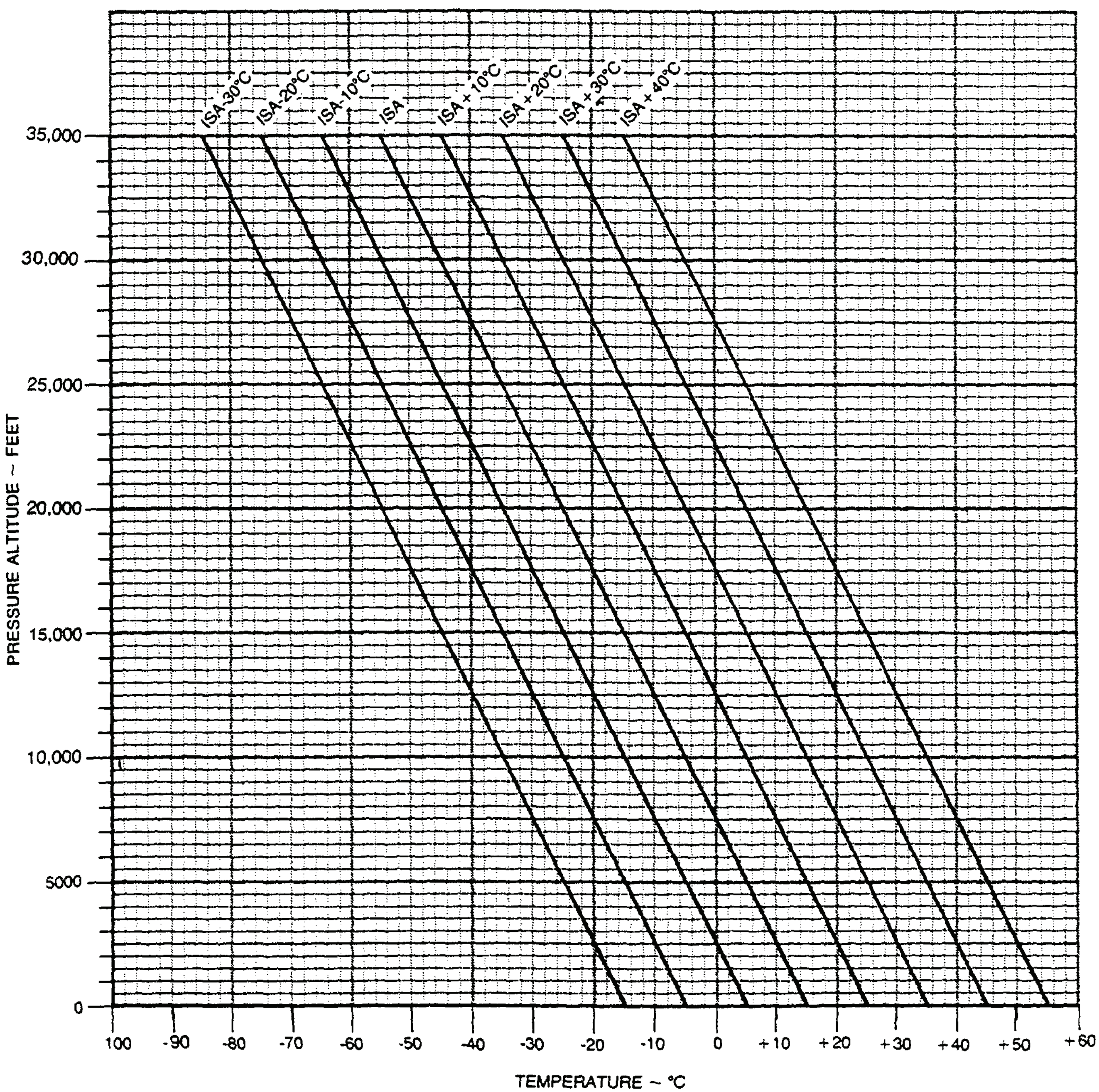


Figure 7-11. ISA Conversion

FAHRENHEIT TO CELSIUS TEMPERATURE CONVERSION

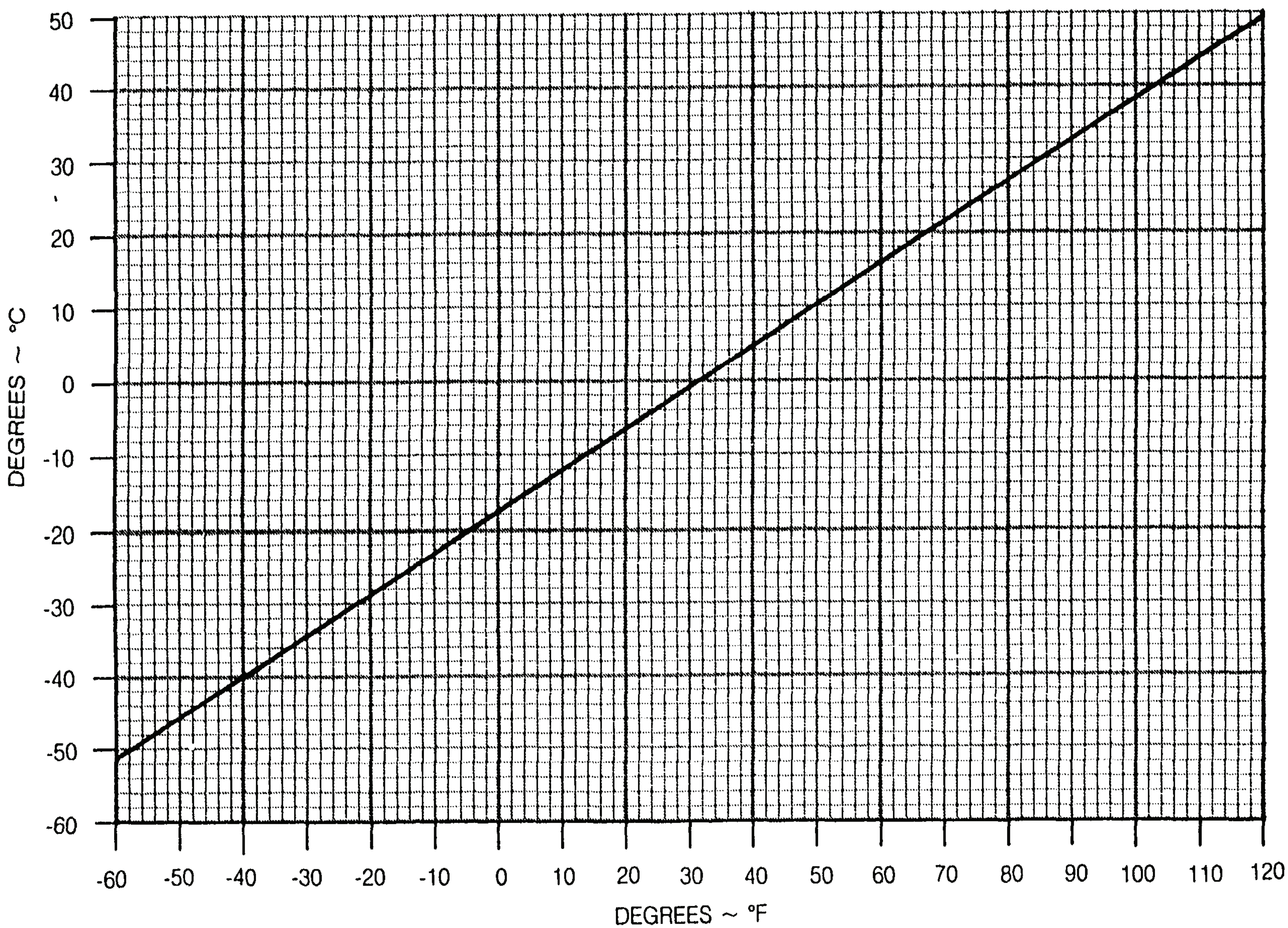


Figure 7-12. Fahrenheit to Celsius Temperature Conversion

STALL SPEEDS-POWER IDLE

NOTES:

1. MAXIMUM ALTITUDE LOSS DURING ABNORMAL STALL RECOVERY IS APPROXIMATELY 1000 FEET.
2. MAXIMUM NOSE DOWN PITCH ATTITUDE AND ALTITUDE LOSS DURING RECOVERY FROM ONE ENGINE INOPERATIVE STALLS PER FAR 23.205 ARE APPROXIMATELY 20° AND 850 FEET RESPECTIVELY.
3. A NORMAL STALL RECOVERY TECHNIQUE MAY BE USED. THE BEST PROCEDURE IS A BRISK FORWARD WHEEL MOVEMENT TO A NOSE DOWN ATTITUDE. LEVEL THE AIRPLANE AFTER AIRSPEED HAS INCREASED APPROXIMATELY 25 KNOTS ABOVE STALL.

EXAMPLE:

WEIGHT	11,700 LBS
FLAPS	APPROACH
ANGLE OF BANK	30°
STALL SPEED	95 KTS CAS 90 KTS IAS

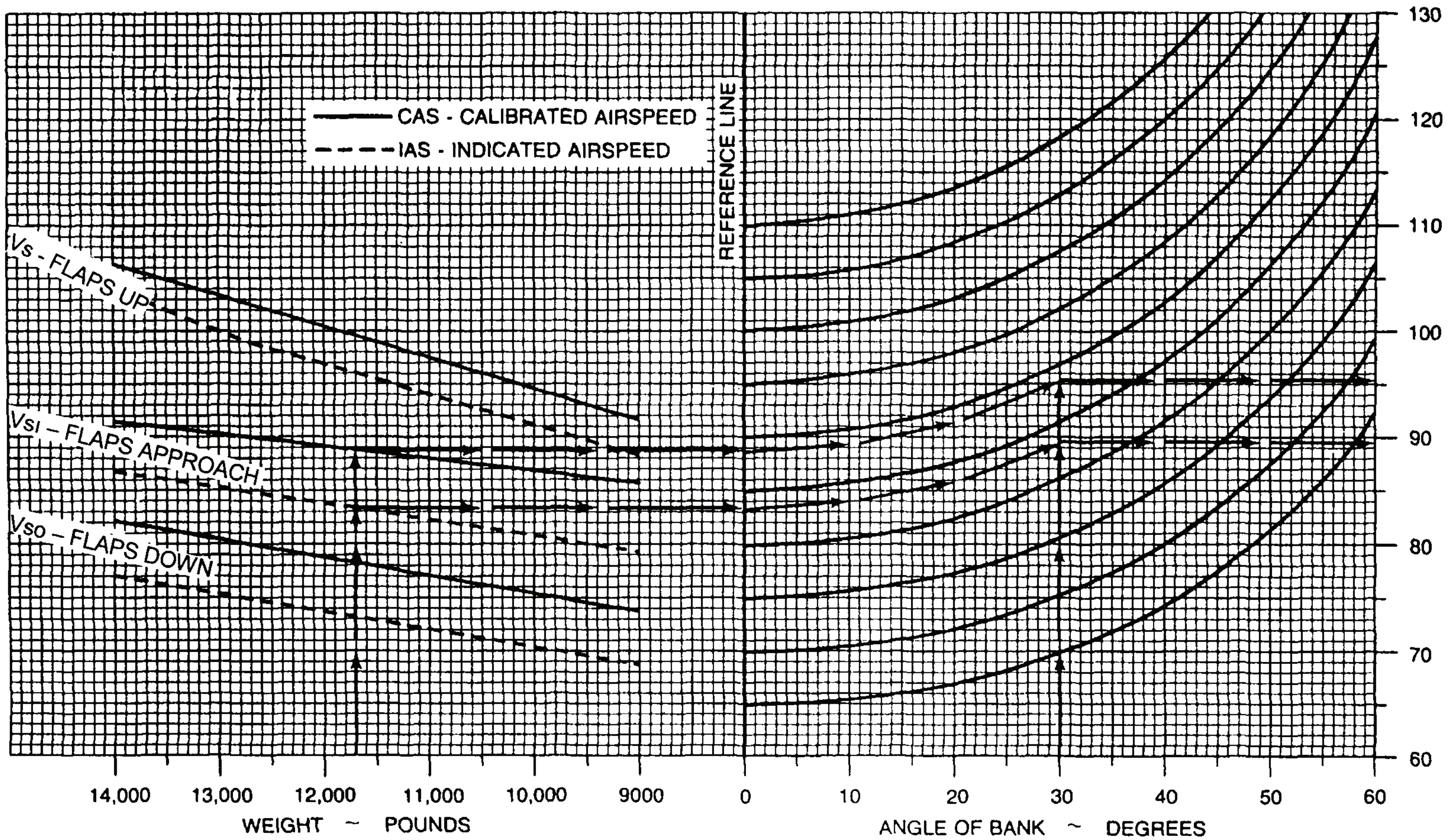


Figure 7-13. Stall Speeds – Power Idle

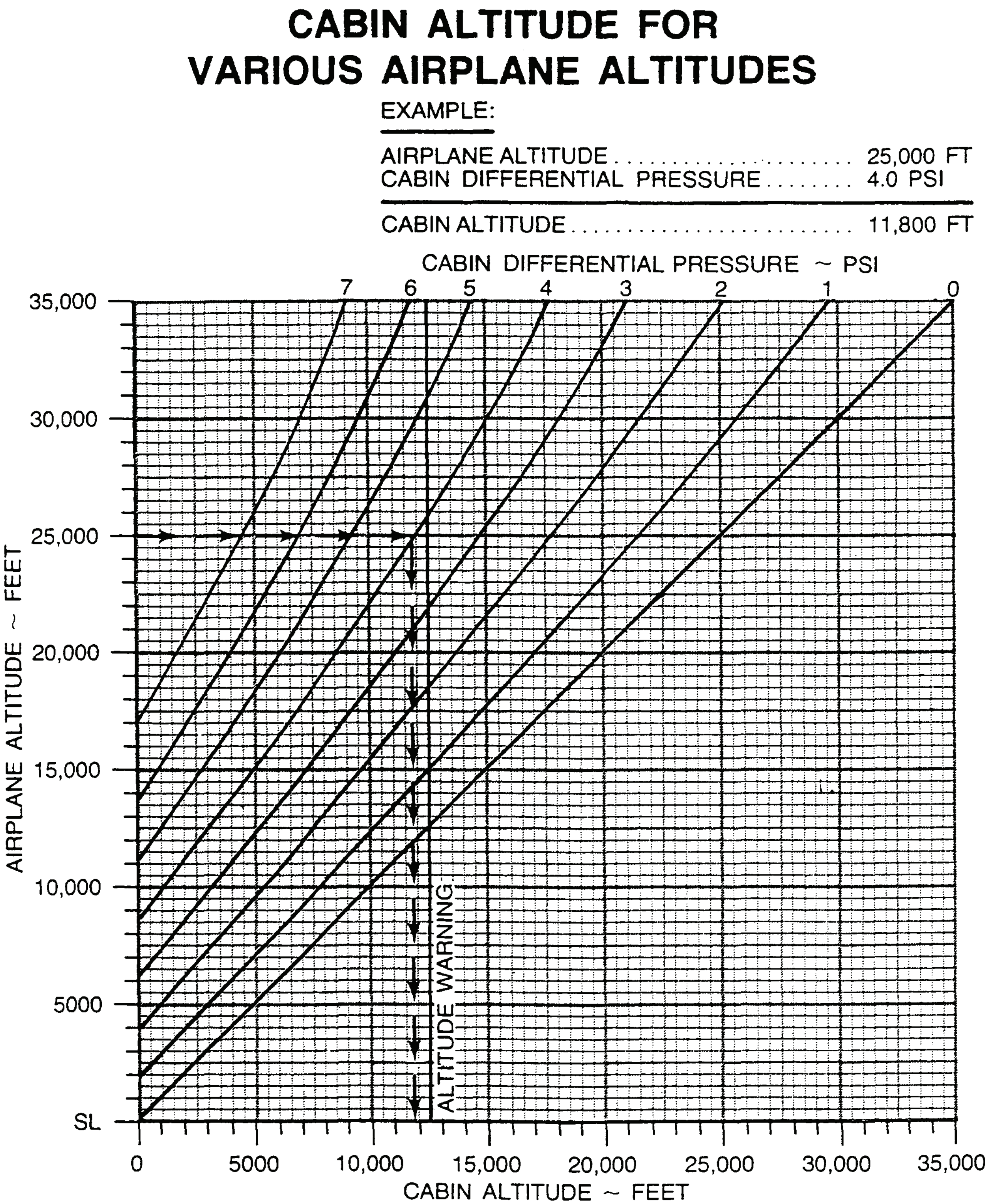


Figure 7-14. Cabin Altitude for Various Airplane Altitudes

TAKE-OFF WEIGHT - FLAPS UP

TO ACHIEVE POSITIVE ONE-ENGINE INOPERATIVE CLIMB AT LIFT-OFF

ASSOCIATED CONDITIONS:

POWER .... TAKE-OFF
FLAPS .... UP
LANDING GEAR .... DOWN

EXAMPLE:

PRESSURE ALTITUDE .... 5433 FT
OAT .... 28°C

TAKE-OFF WEIGHT NORMAL CATEGORY .... 12,500 LBS
TAKE-OFF WEIGHT RESTRICTED CATEGORY .... 13,550 LBS

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, NO OFF-LOADING IS REQUIRED.

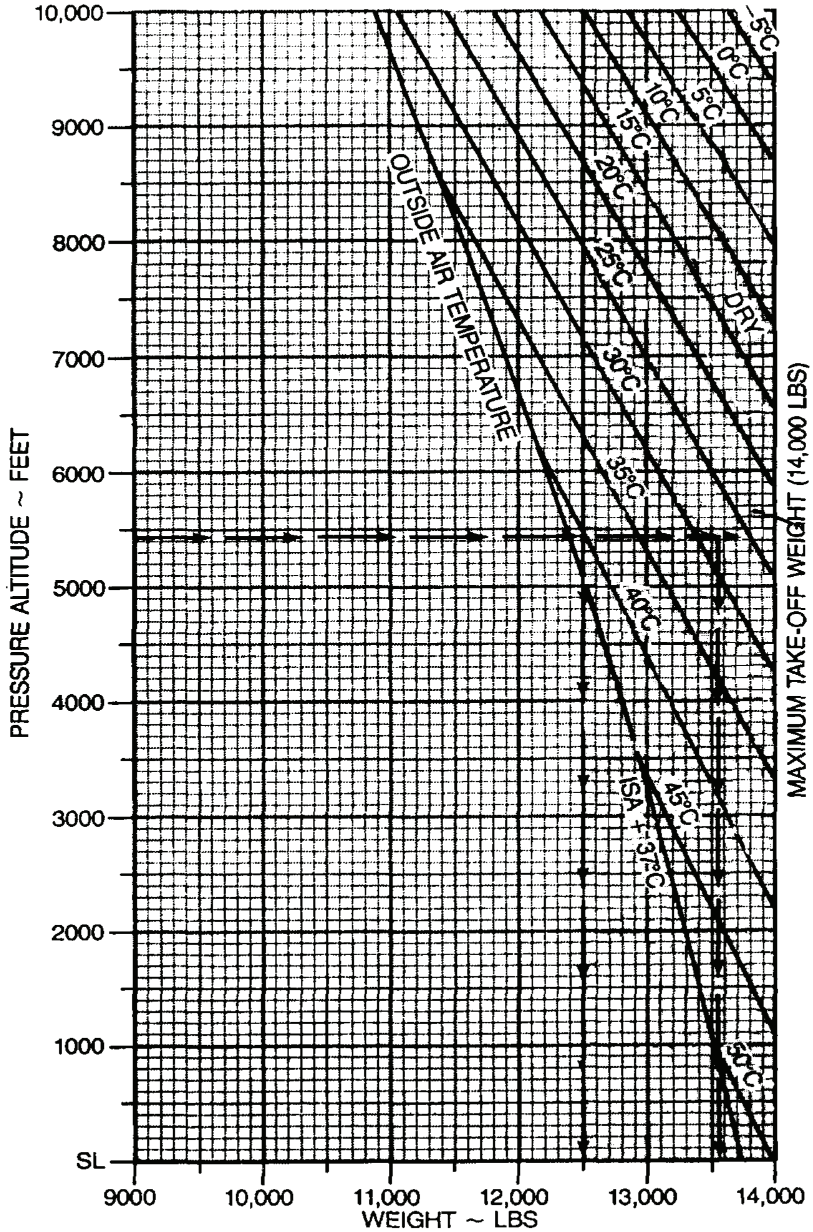


Figure 7-15. Takeoff Weight to Achieve Positive One-Engine-Inoperative Climb at Lift-Off, Flaps UP

TAKE-OFF WEIGHT - FLAPS APPROACH

TO ACHIEVE POSITIVE ONE-ENGINE INOPERATIVE CLIMB AT LIFT-OFF

ASSOCIATED CONDITIONS:

POWER .... TAKE-OFF
FLAPS .... APPROACH
LANDING GEAR .... DOWN

EXAMPLE:

PRESSURE ALTITUDE .... 5433 FT
OAT .... 28°C

TAKE-OFF WEIGHT.................. 12,340 LBS

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, ADD 10°C TO THE ACTUAL OAT BEFORE ENTERING GRAPH

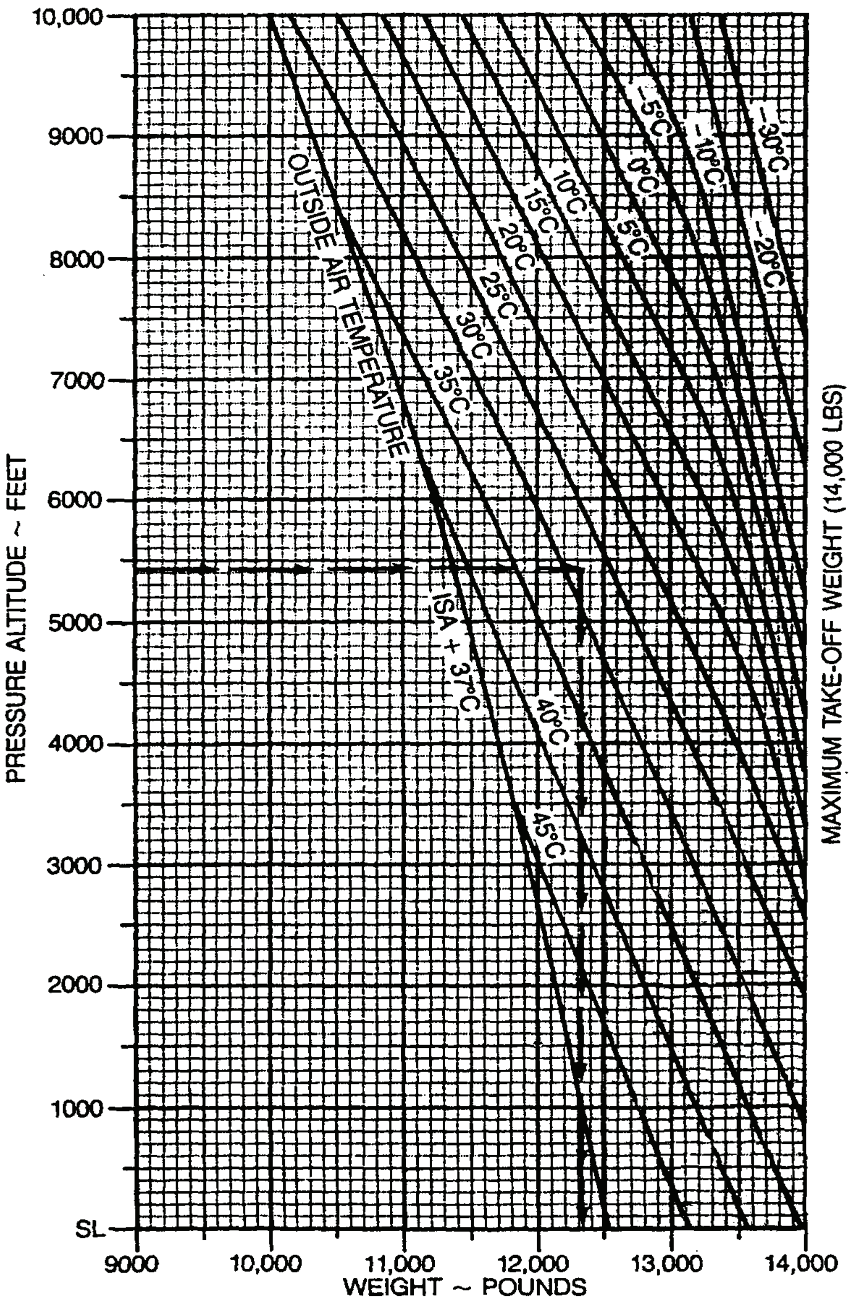


Figure 7-16. Takeoff Weight to Achieve Positive One-Engine-Inoperative Climb at Lift-Off, Flaps APPROACH

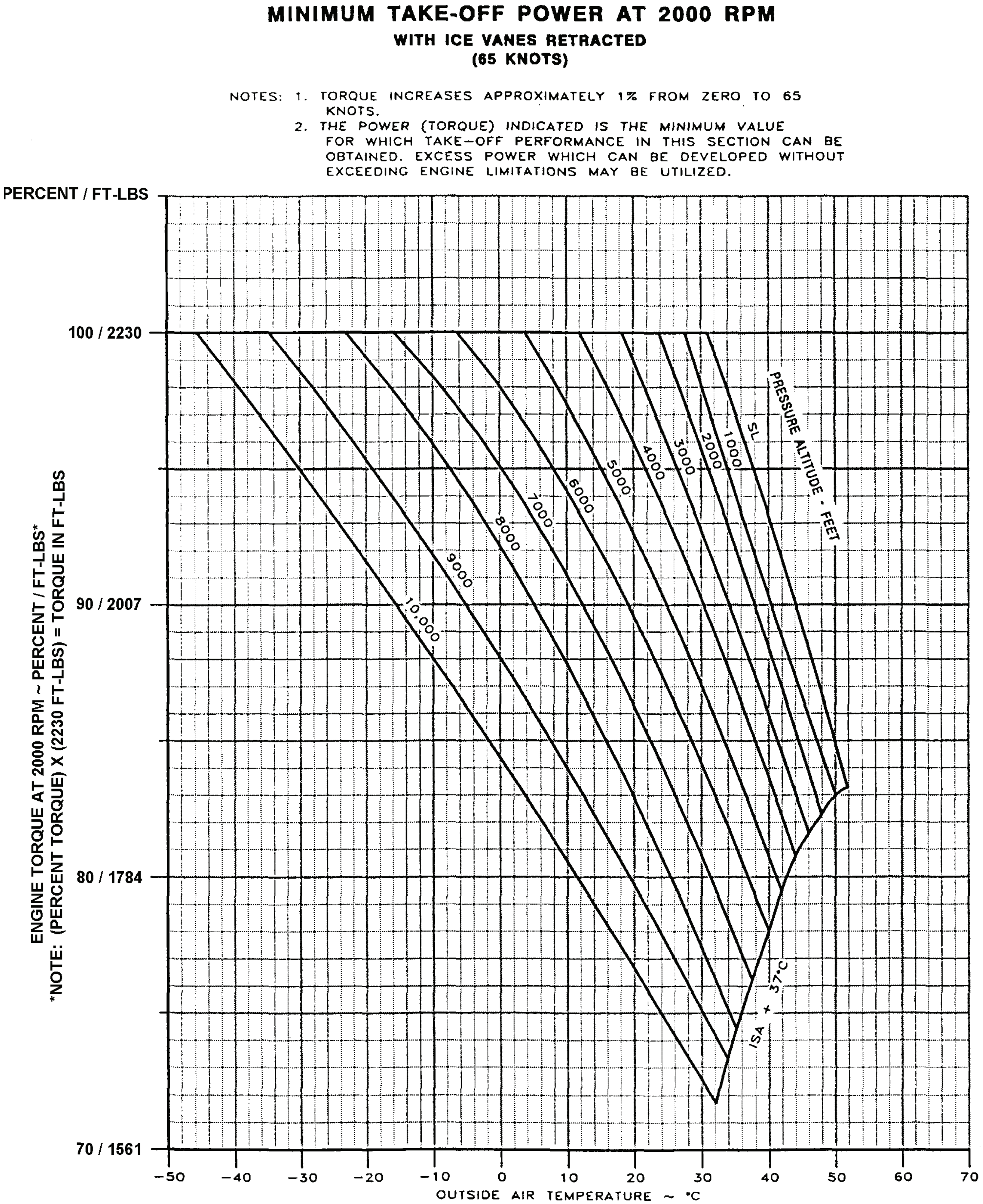


Figure 7-17. Minimum Takeoff Power at 2000 RPM With Ice Vanes Retracted (65 Knots)

MINIMUM TAKE-OFF POWER
WITH ICE VANES EXTENDED
(65 KNOTS)

NOTES:
1. TORQUE INCREASES APPROXIMATELY 1% FROM ZERO TO 65 KNOTS.
2. THE POWER (TORQUE) INDICATED IS THE MINIMUM VALUE AT 65 KNOTS FOR WHICH TAKE-OFF PERFORMANCE IN THIS SECTION CAN BE OBTAINED. TORQUE WILL CONTINUE TO INCREASE ABOVE 65 KNOTS.
3. TAKE-OFF WITH VANES EXTENDED ABOVE +15°C IS PROHIBITED.

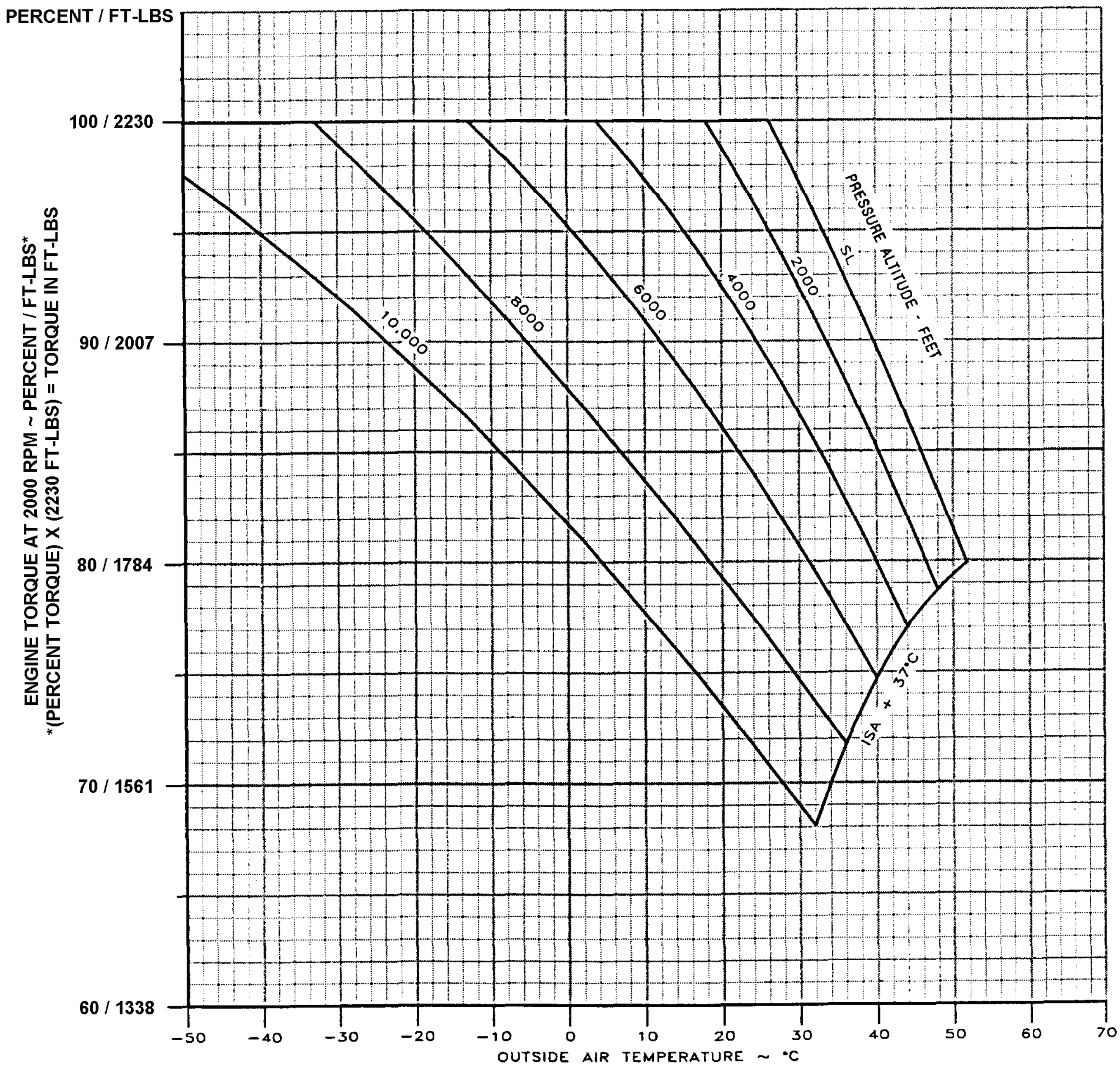


Figure 7-18. Minimum Takeoff Power With Ice Vanes Extended (65 Knots)

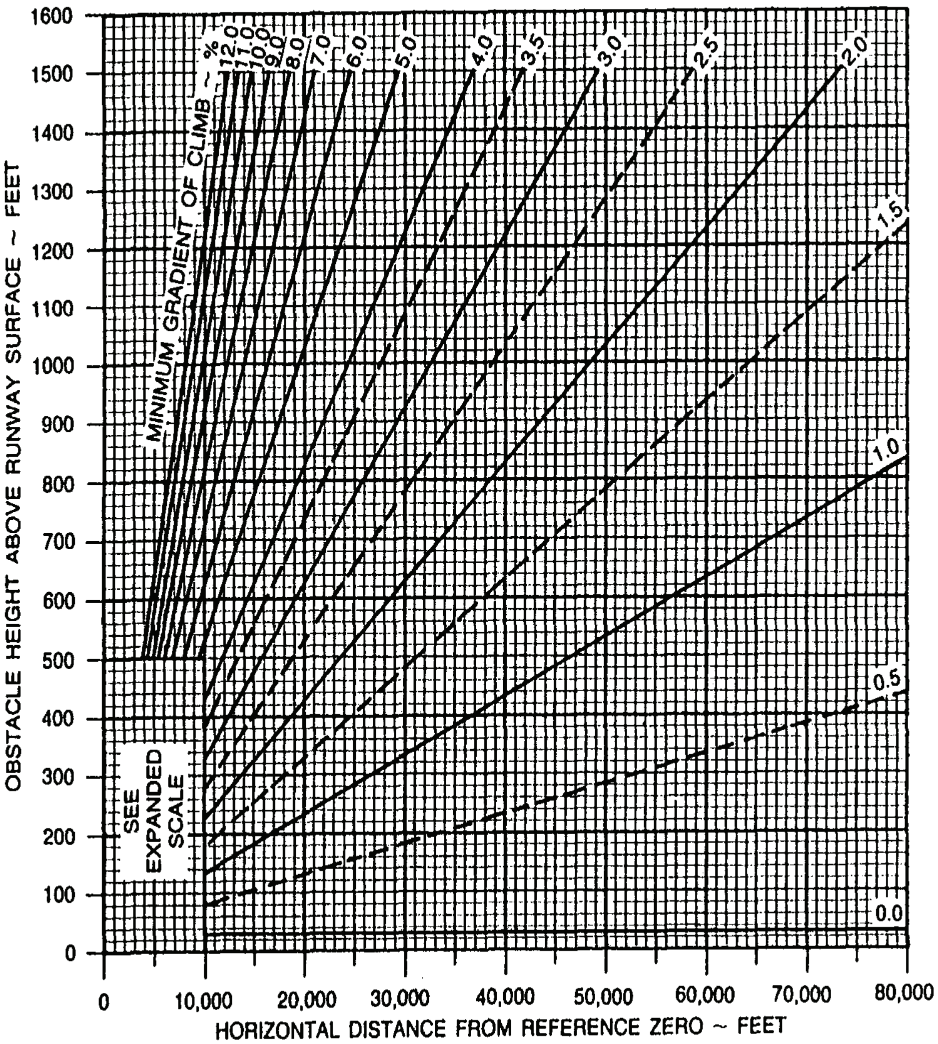
TAKE-OFF FLIGHT PATH

REFERENCE ZERO: THE POINT AT THE END OF THE TAKE-OFF RUN AT WHICH THE AIRPLANE IS 35 FEET ABOVE THE RUNWAY SURFACE.

EXAMPLE:

OBSTACLE HEIGHT . . . . 175 FEET

HORIZONTAL DISTANCE FROM REFERENCE ZERO ~ FEET	MINIMUM GRADIENT OF CLIMB ~ %
2700	5.2



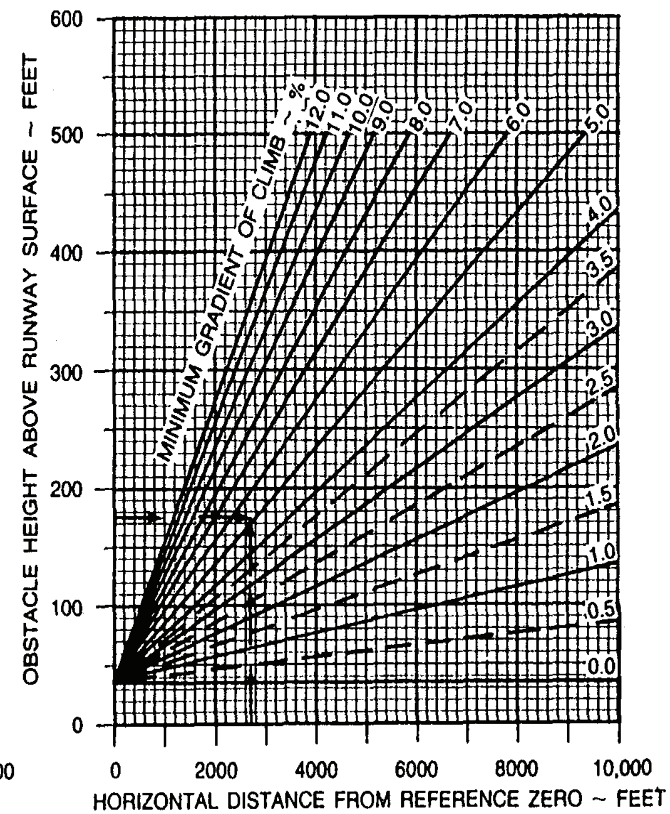


Figure 7-19. Takeoff Flight Path

WIND COMPONENTS

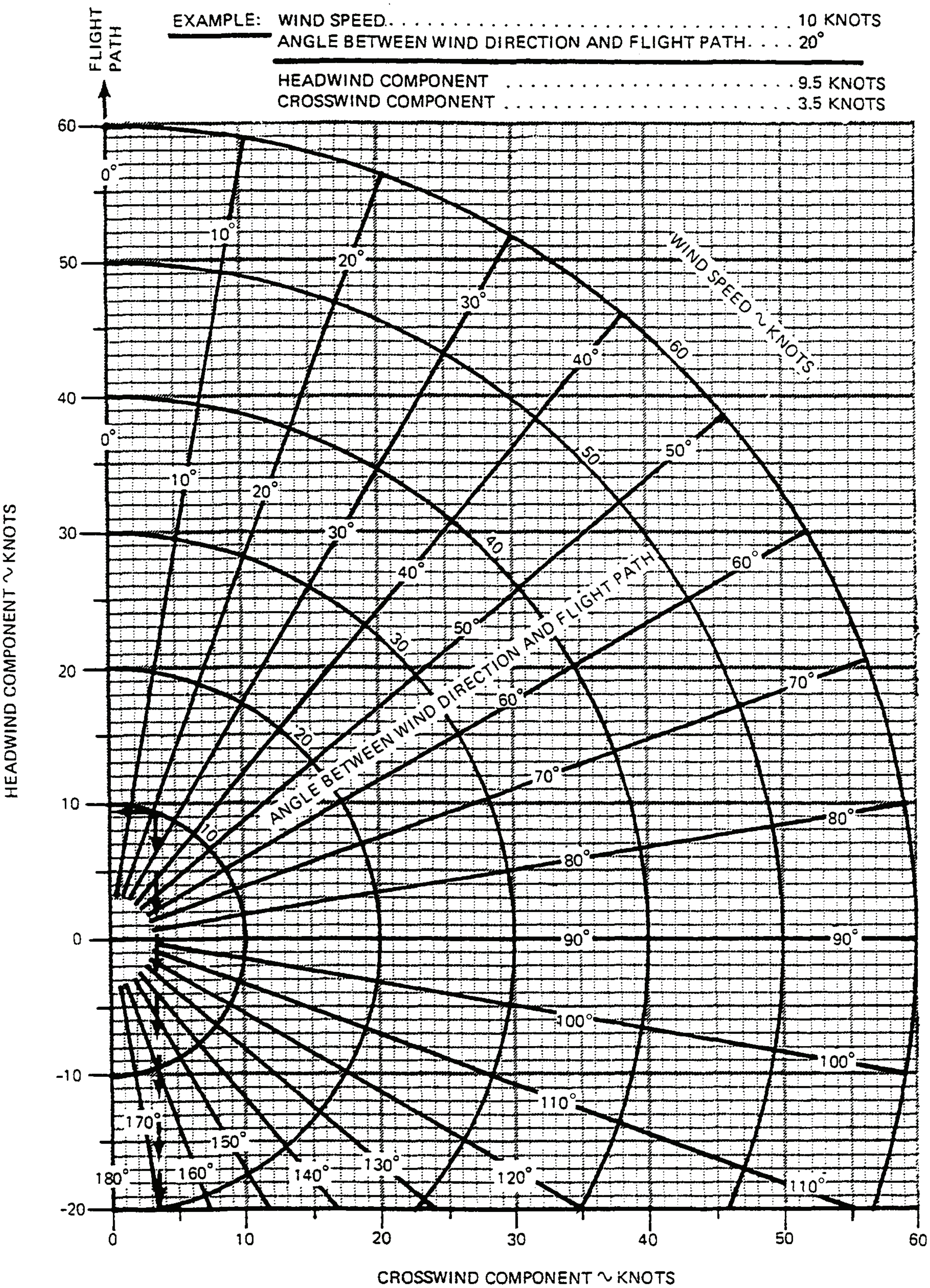


Figure 7-20. Wind Component

TAKE-OFF DISTANCE* - FLAPS UP

ASSOCIATED CONDITIONS:

POWER............. TAKE-OFF POWER SET BEFORE BRAKE RELEASE
FLAPS.............. UP
LANDING GEAR...... RETRACT AFTER LIFT-OFF
RUNWAY............ PAVED, LEVEL, DRY SURFACE

* NOTE: ADD OR SUBTRACT 5% OF TAKE-OFF GROUND ROLL FOR EACH 1% OF RUNWAY SLOPE, (DOWN - SUBTRACT, UP - ADD).

WEIGHT ~ POUNDS	TAKE-OFF SPEEDS ~ KNOTS	
	V_1**	V_2
14,000	117	126
13,000	113	123
12,500	111	121
12,000	109	120
11,000	105	115
10,000	101	111
9000	98	108

**NOTE: $V_1 = V_r$

EXAMPLE:

OAT .... 28°C
PRESSURE ALTITUDE .... 5433 FT
TAKE-OFF WEIGHT..................... 12,500 LBS
HEADWIND COMPONENT .... 9.5 KTS

GROUND ROLL........................ 3800 FT
TOTAL DISTANCE OVER 50 FT OBSTACLE .... 5100 FT
TAKE-OFF SPEED AT ROTATION .... 111 KTS
V_2 .... 121 KTS

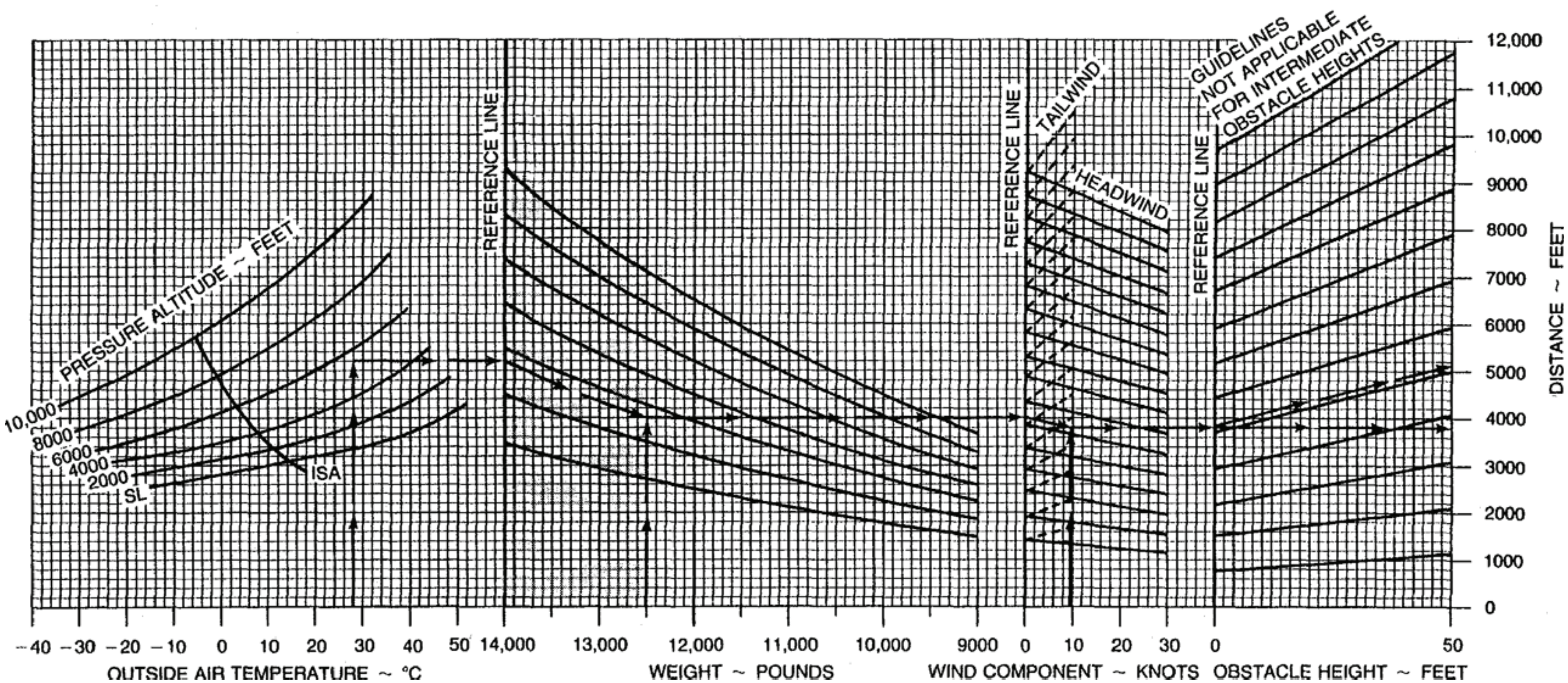


Figure 7-21. Take-Off Distance, Flaps UP

ACCELERATE-STOP – FLAPS – UP

ASSOCIATED CONDITIONS:

POWER .... 1. TAKE-OFF POWER SET BEFORE BRAKE RELEASE
2. BOTH ENGINES IDLE AT V_1 SPEED AND REVERSE OPERATING ENGINE

FLAPS .... UP
AUTOFEATHER....ARMED
BRAKING............MAXIMUM
RUNWAY............PAVED, LEVEL DRY SURFACE

WEIGHT~POUNDS	V_1~KNOTS
14,000	117
13,000	113
12,500	111
12,000	109
11,000	105
10,000	101
9,000	98

EXAMPLE:

OAT... 28°c
PRESSURE ALTITUDE..................... 5430
WEIGHT... 12500 LBS
HEADWIND COMPONENT................. 9.5 KNTS

FIELD LENGTH................................ 5800*
V_1 .... 111 KTS

*NOTE: ADD OR SUBTRACT 2% OF TOTAL DISTANCE FOR EACH 1% OF RUNWAY SLOPE (DOWN – SUBTRACT, UP – ADD).

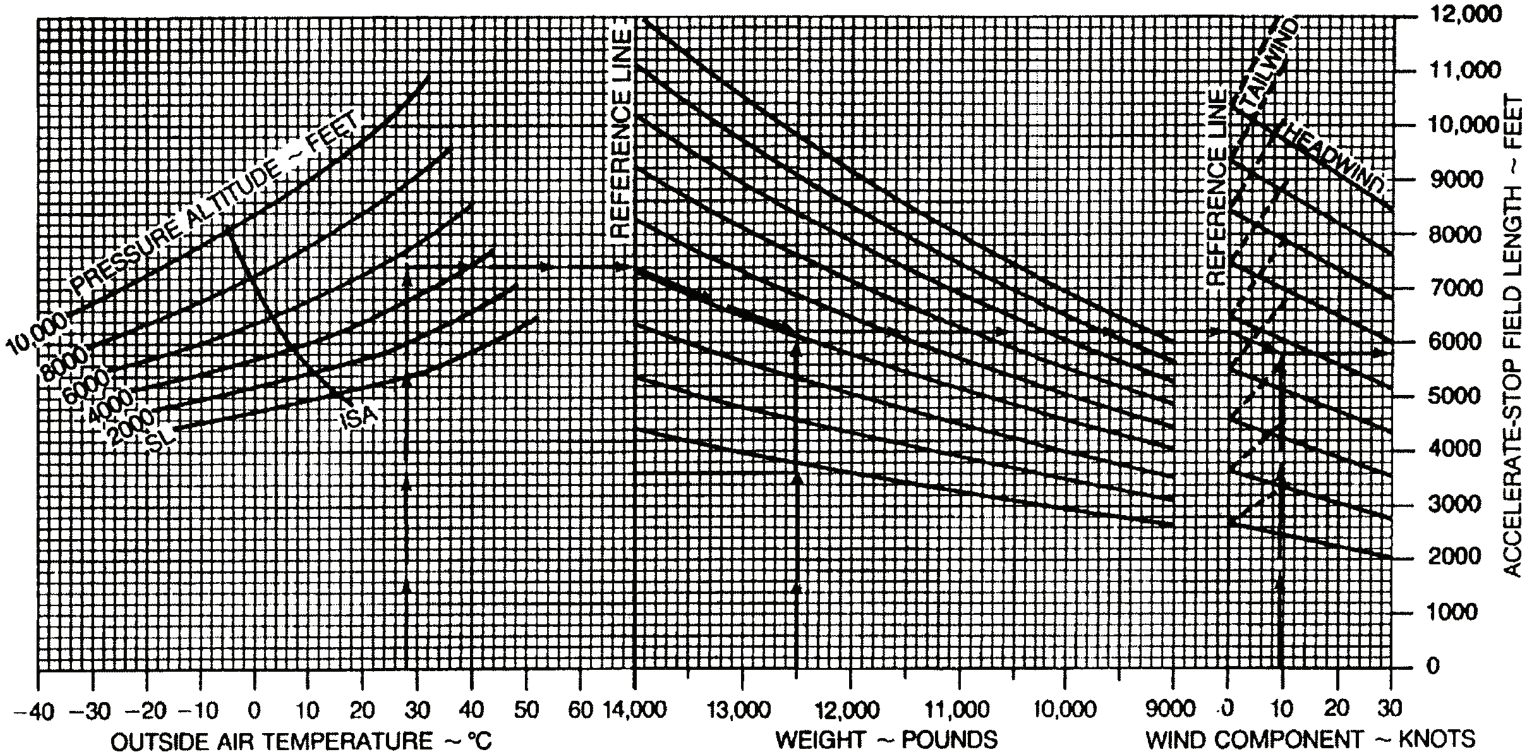


Figure 7-22. Accelerate – Stop, Flaps UP

ACCELERATE - GO - FLAPS UP

ASSOCIATED CONDITIONS:

POWER .... TAKE-OFF POWER SET BEFORE BRAKE RELEASE
FLAPS .... UP
AUTOFEATHER .... ARMED
LANDING GEAR .... RETRACT AFTER LIFT-OFF
RUNWAY .... PAVED, LEVEL, DRY SURFACE

NOTES:
1. AIR DISTANCE IS 50% OF TAKE-OFF DISTANCE OVER 35-FT OBSTACLE.
2. DISTANCES ASSUME AN ENGINE FAILURE AT ROTATION SPEED AND PROPELLER IMMEDIATELY FEATHERED.
3. USABLE CLEARWAY CANNOT EXCEED 25% OF THE RUNWAY LENGTH.
4. WEIGHTS IN ▨ AREA ARE NOT AUTHORIZED FOR TAKE-OFF.

WEIGHT ~ POUNDS	SPEED ~ KNOTS	
	V_1^*	V_2
14,000	117	126
13,000	113	125
12,500	111	121
12,000	109	120
11,000	105	115
10,000	101	111
9000	98	108

*NOTE: $V_1 = V_R$

EXAMPLE:

OAT .... 28°C
PRESSURE ALTITUDE .... 5430 FT
HEADWIND COMPONENT .... 9.5 KTS

TAKE-OFF WEIGHT ~ POUNDS	TAKE-OFF FIELD LENGTH ~ FEET
12,500	9600
11,280	6786
10,370	5800

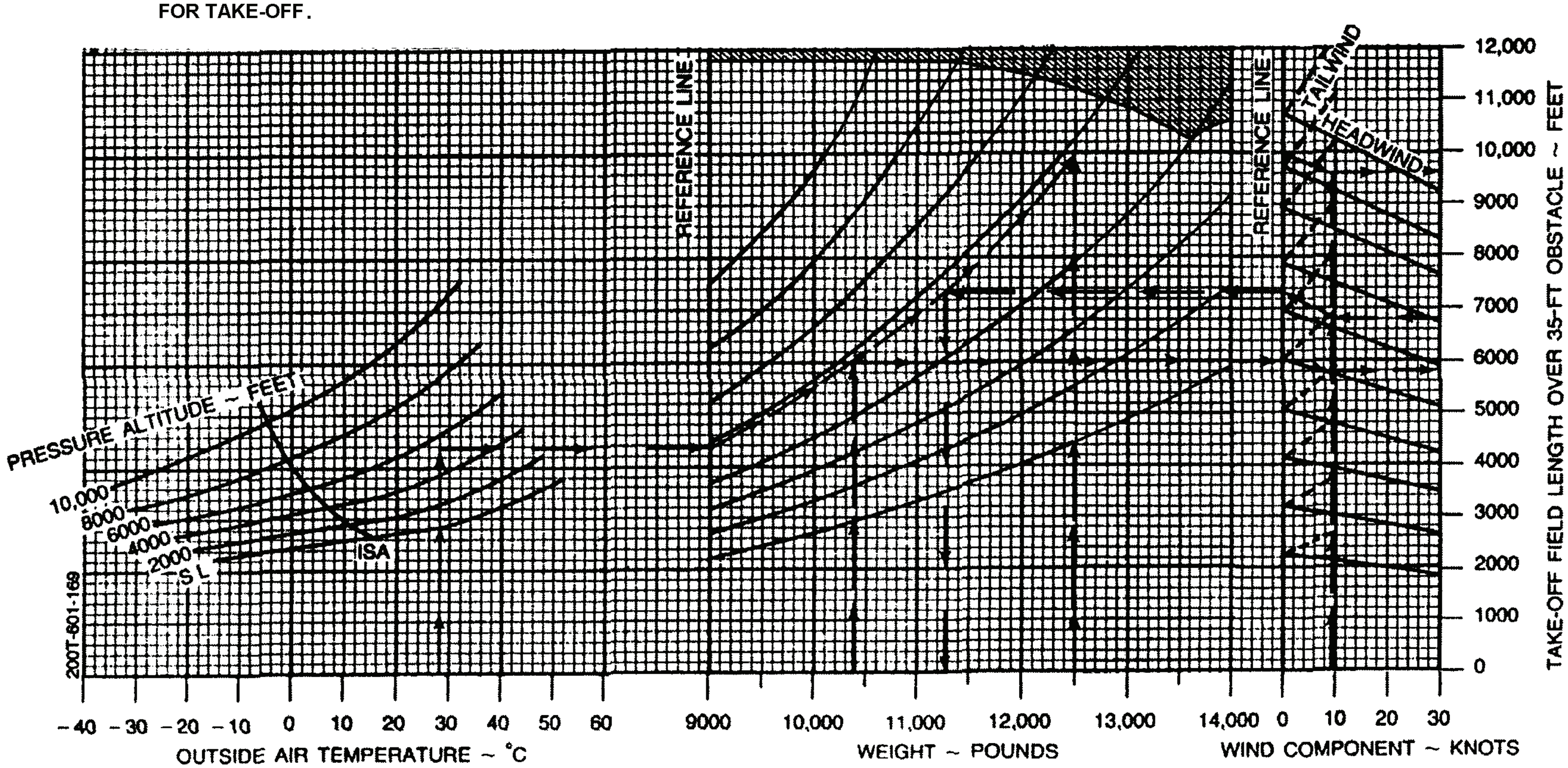


Figure 7-23. Accelerate – Go, Flaps UP

NET GRADIENT OF CLIMB - FLAPS UP

ASSOCIATED CONDITIONS:

POWER .... TAKEOFF
FLAPS .... UP
GEAR .... UP
INOPERATIVE PROPELLER ...... FEATHERED

WEIGHT ~ POUNDS	CLIMB SPEED(V2)~KNOTS
14,000	126
13,000	123
12,500	121
12,000	120
11,000	115
10,000	111
9000	108

NOTE:

NET GRADIENT OF CLIMB
IS EQUAL TO ACTUAL GRADIENT OF CLIMB IN PERCENT MINUS 0.8 PERCENT

EXAMPLE:

OAT .... 28°C
PRESSURE ALTITUDE .... 5430 FT

TAKE-OFF WEIGHT ~ POUNDS	NET GRADIENT ~ %
11,280	3.0
9380	5.2
10,370	3.9

CLIMB SPEED @ 10,370 LBS .... 112 KTS

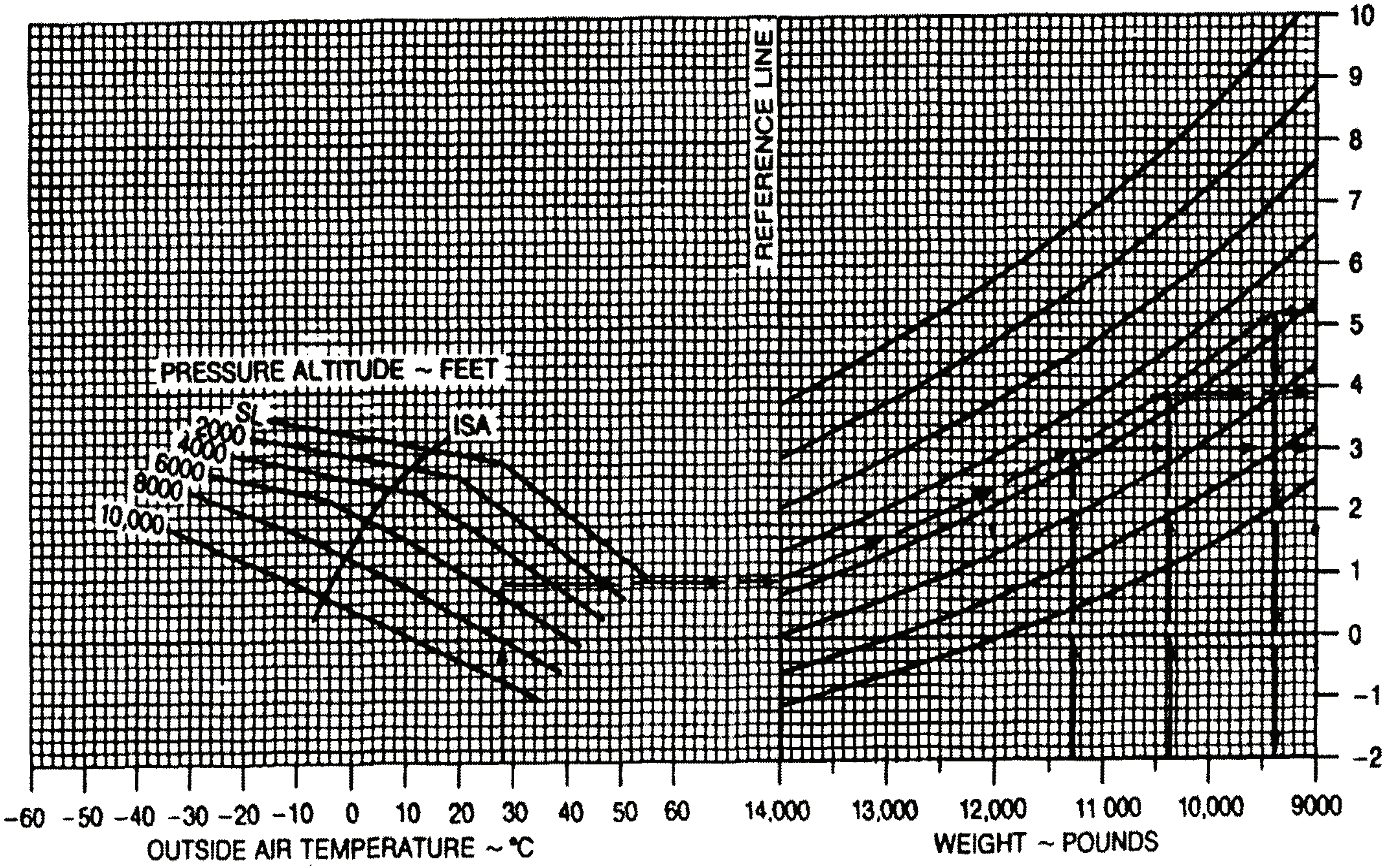


Figure 7-24. Net Gradient of Climb, Flaps UP

TAKE-OFF DISTANCE* - FLAPS APPROACH

ASSOCIATED CONDITIONS:

POWER............. TAKE-OFF POWER SET BEFORE BRAKE RELEASE
FLAPS.............. APPROACH
LANDING GEAR...... RETRACT AFTER LIFT-OFF
RUNWAY............ PAVED, LEVEL, DRY SURFACE

* NOTE: ADD OR SUBTRACT 5% OF TAKE-OFF GROUND ROLL FOR EACH 1% OF RUNWAY SLOPE (DOWN - SUBTRACT, UP - ADD)

WEIGHT ~ POUNDS	TAKE-OFF SPEED ~ KNOTS	
	V_1**	V_X
14,000	98	108
13,000	96	106
12,500	96	105
12,000	95	104
11,000	94	103
10,000	94	101
9000	94	99

**NOTE: $V_1 = V_r$

EXAMPLE:

OAT................................ 28°C
PRESSURE ALTITUDE................. 5433 FT
TAKE-OFF WEIGHT................... 12,500 LBS
HEADWIND COMPONENT............... 9.5 KTS

GROUND ROLL....................... 2600 FT
TOTAL DISTANCE OVER 50 FT OBSTACLE..................... 3750 FT
TAKE-OFF SPEED AT V_1.............. 96 KTS
V_X................................ 105 KTS

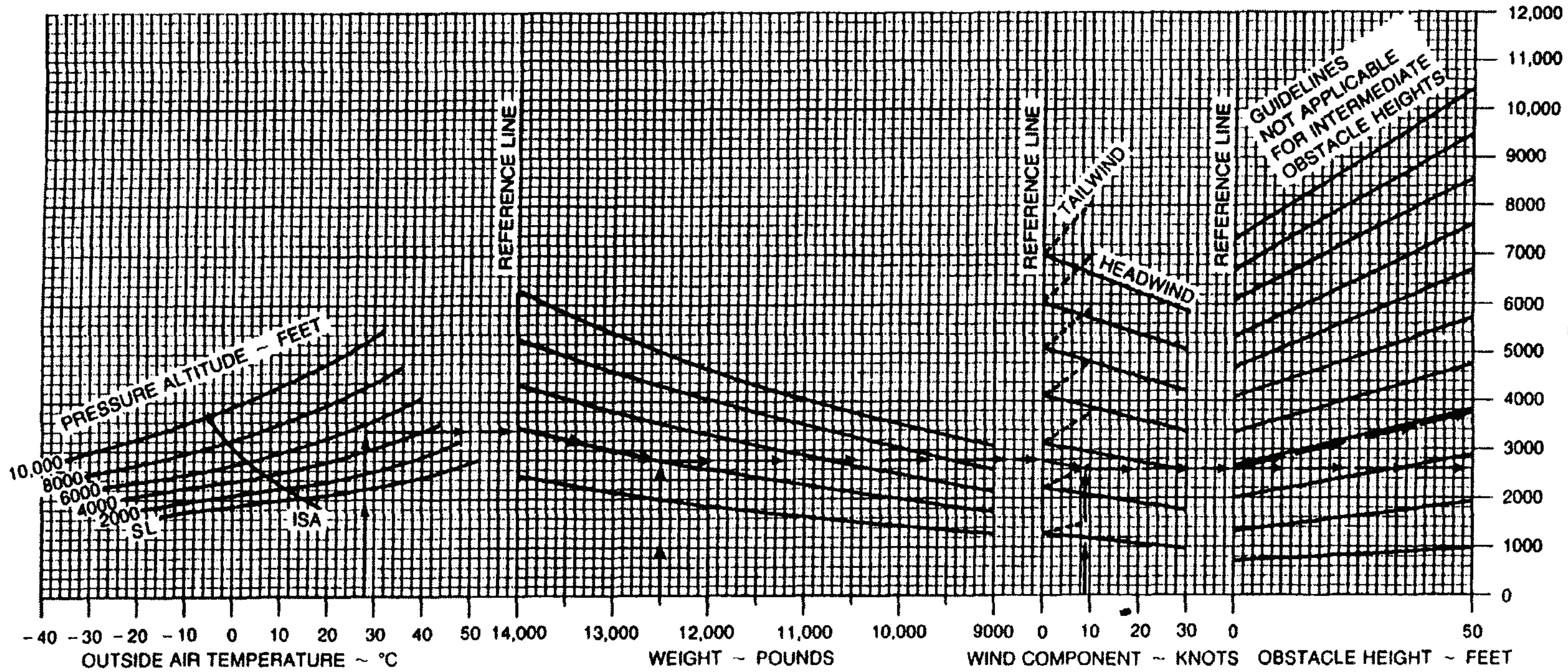


Figure 7-25. Takeoff Distance, Flaps APPROACH

ACCELERATE-STOP - FLAPS APPROACH

ASSOCIATED CONDITIONS:

POWER .... 1. TAKE-OFF POWER SET BEFORE BRAKE RELEASE
2. BOTH ENGINES IDLE AT V_1 SPEED AND REVERSE OPERATING ENGINE

FLAPS .... APPROACH
AUTOFEATHER . ARMED
BRAKING .... MAXIMUM
RUNWAY .... PAVED, LEVEL, DRY SURFACE

WEIGHT ~ POUNDS	V_1 ~ KNOTS
14,000	98
13,000	96
12,500	96
12,000	95
11,000	94
10,000	94
9000	94

EXAMPLE:

OAT .... 28°C
PRESSURE ALTITUDE .... 5430 FT
WEIGHT .... 11,820 LBS
HEADWIND COMPONENT .... 9.5 KTS

FIELD LENGTH .... 4300 FT *
V_1 .... 95 KTS

* NOTE: ADD OR SUBTRACT 2% OF TOTAL DISTANCE FOR EACH 1% OF RUNWAY SLOPE (DOWN - SUBTRACT, UP - ADD).

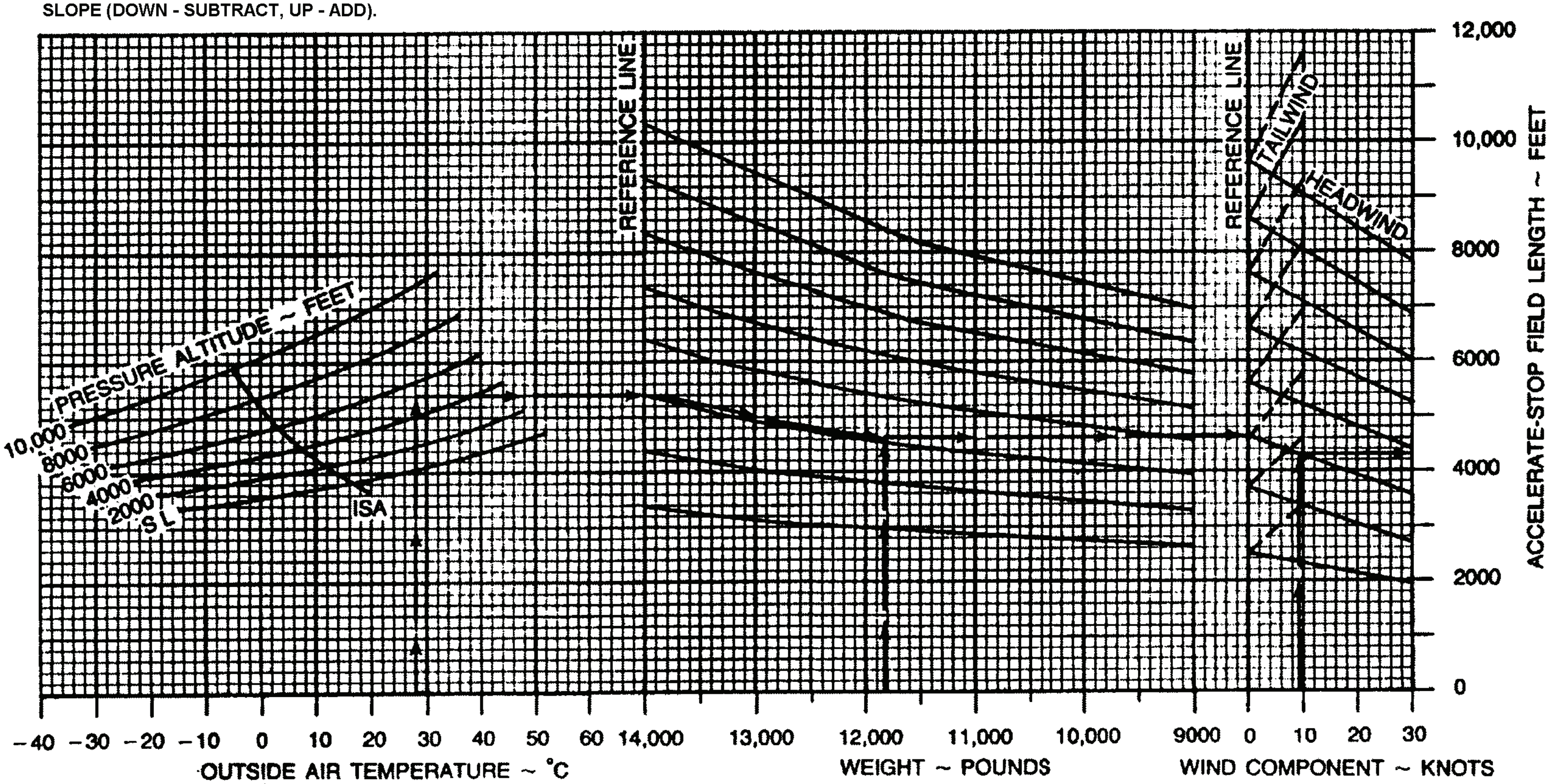


Figure 7-26. Accelerate – Stop Flaps APPROACH

ACCELERATE-GO - FLAPS APPROACH

ASSOCIATED CONDITIONS:

POWER	TAKE-OFF POWER SET BEFORE BRAKE RELEASE
FLAPS	APPROACH
AUTOFEATHER	ARMED
LANDING GEAR	RETRACT AFTER LIFT-OFF
RUNWAY	PAVED, LEVEL, DRY SURFACE

NOTES:
1. AIR DISTANCE IS 60% OF TAKE-OFF DISTANCE OVER 35-FT OBSTACLE.
2. DISTANCES ASSUME AN ENGINE FAILURE AT ROTATION SPEED AND PROPELLER IMMEDIATELY FEATHERED.
3. USABLE CLEARWAY CANNOT EXCEED 25% OF THE RUNWAY LENGTH.
4. WEIGHTS IN [hatched] AREA ARE NOT AUTHORIZED FOR TAKEOFF.

WEIGHT ~ POUNDS	SPEED ~ KNOTS	
	V_1	V_2
14,000	98	108
13,000	96	106
12,500	96	105
12,000	95	104
11,000	94	103
10,000	94	101
9000	94	99

EXAMPLE:

OAT	28°C
PRESSURE ALTITUDE	5430 FT.
HEADWIND COMPONENT	9.5 KTS.

TAKE-OFF WEIGHT ~ POUNDS	TAKE-OFF FIELD LENGTH ~ FEET
11,820	7300
11,520	6786
10,175	4820

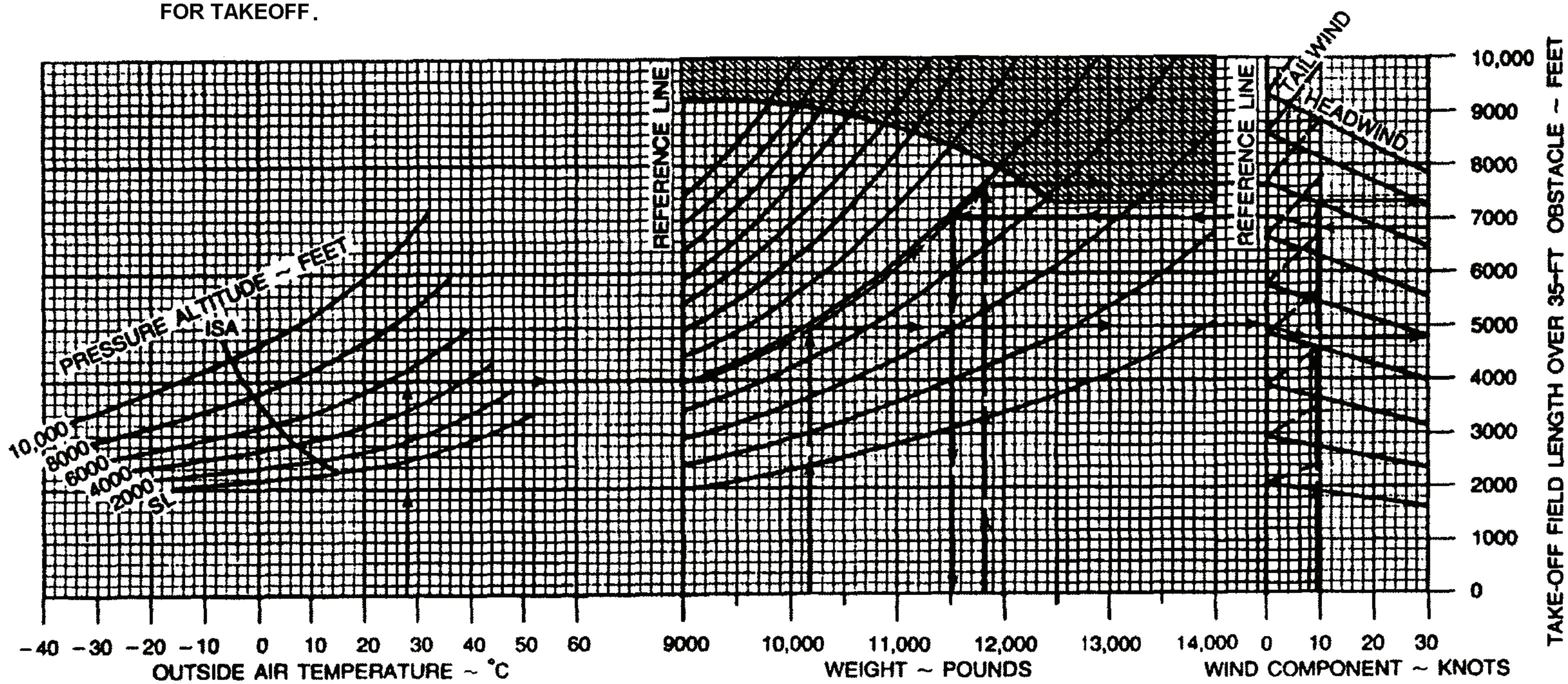


Figure 7-27. Accelerate – Go, Flaps APPROACH

NET GRADIENT OF CLIMB - FLAPS APPROACH

ASSOCIATED CONDITIONS:

POWER .... TAKE-OFF
FLAPS .... APPROACH
LANDING GEAR .... UP
INOPERATIVE
PROPELLER .... FEATHERED

WEIGHT ~ POUNDS	CLIMB SPEED V_2 ~KNOTS
14,000	108
13,000	106
12,500	105
12,000	104
11,000	103
10,000	101
9000	99

EXAMPLE:

OAT .... 28°C
PRESSURE ALTITUDE .... 5430 FT

TAKE-OFF WEIGHT ~ POUNDS	NET GRADIENT ~ %
11,520	1.5
LESS THAN 9000	5.2
10,175	3.0

CLIMB SPEED V_2
@ 10,175 LBS. .... 101 KTS

NOTE: NET GRADIENT OF CLIMB IS EQUAL TO ACTUAL GRADIENT OF CLIMB IN PERCENT MINUS 0.8 PERCENT

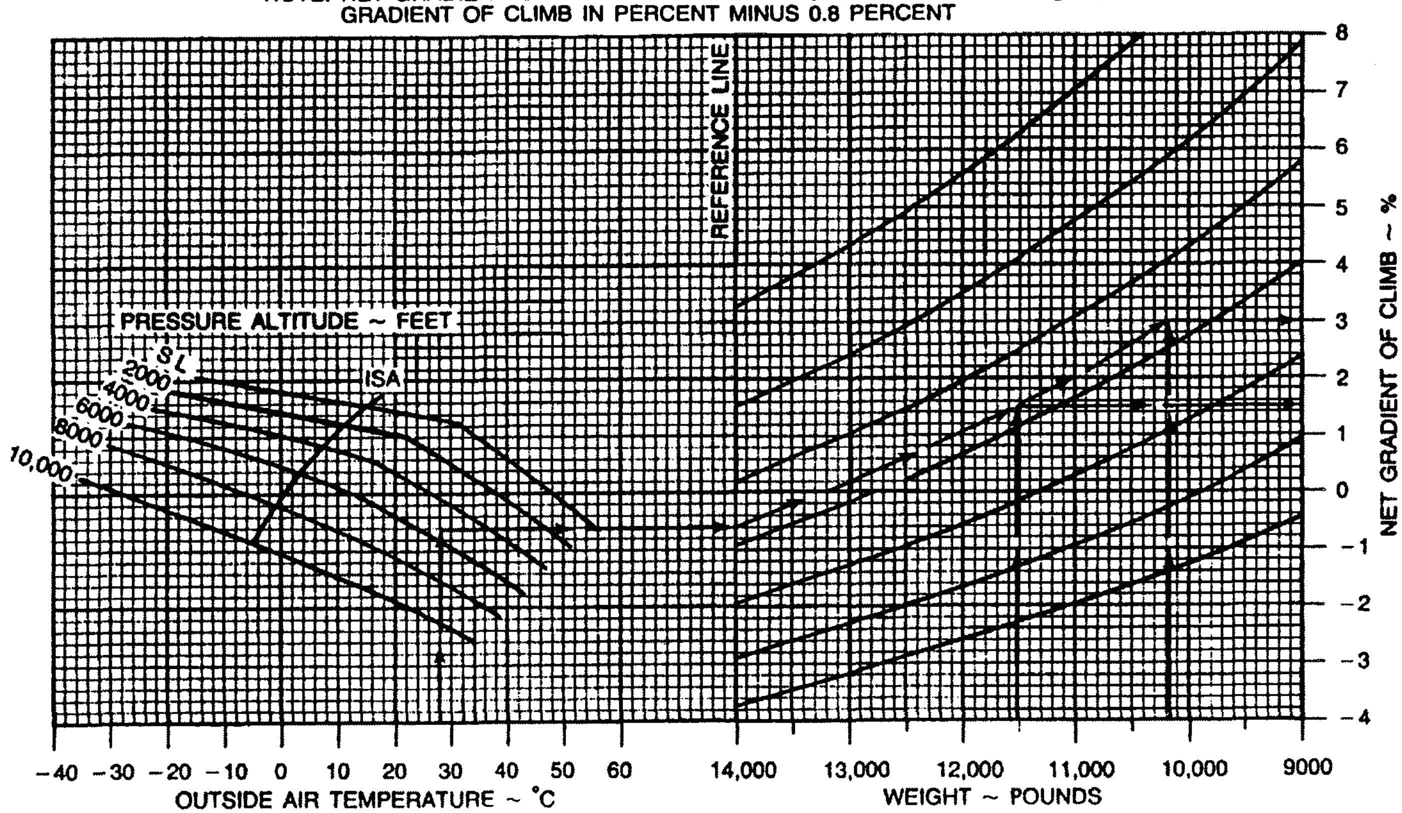


Figure 7-28. Net Gradient of Climb, Flaps APPROACH

CLIMB - TWO ENGINES - FLAPS UP

ASSOCIATED CONDITIONS:

POWER .... MAXIMUM CONTINUOUS
FLAPS .... UP
LANDING GEAR .... UP

SUBTRACT 100 FT. PER MINUTE FROM GRAPH VALUE

WEIGHT ~ POUNDS	CLIMB SPEED V_2 ~ KNOTS
14,000	129
13,000	126
12,500	125
12,000	123
11,000	121
10,000	118
9000	115

EXAMPLE:

OAT .... -6°C
PRESSURE ALTITUDE .... 18,000 FT
WEIGHT .... 12,391 LBS

RATE OF CLIMB .... 1340 FT/MIN
CLIMB GRADIENT 7.9%
CLIMB SPEED V_2............. 125 KNOTS

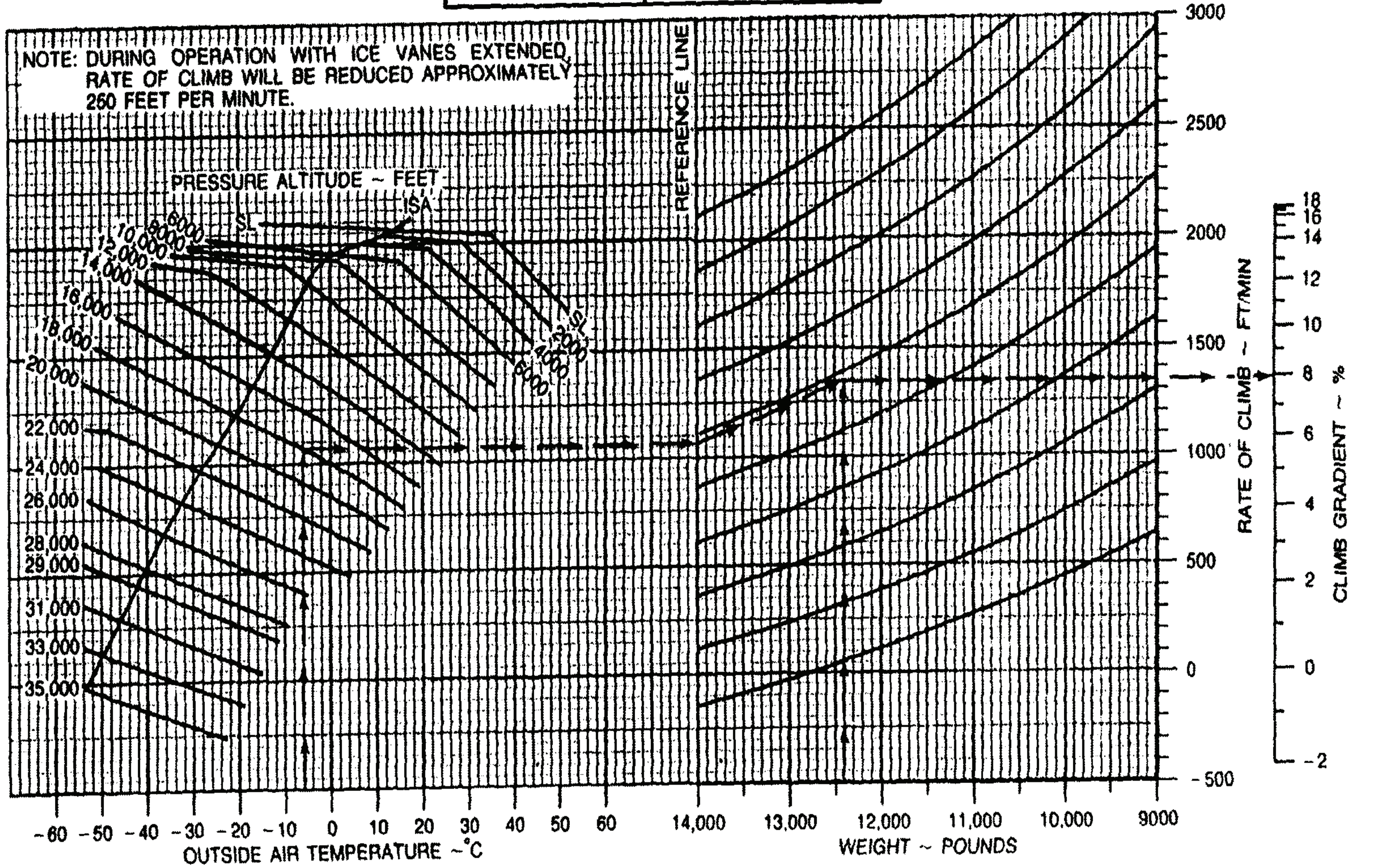


Figure 7-29. Climb – Two Engines, Flaps UP

CLIMB - TWO ENGINES - FLAPS APPROACH

ASSOCIATED CONDITIONS:

POWER .... MAXIMUM CONTINUOUS
FLAPS .... APPROACH
LANDING GEAR .... UP

SUBTRACT 100 FT. PER MINUTE FROM GRAPH VALUE

WEIGHT ~ POUNDS	CLIMB SPEED V2 ~ KNOTS
14,000	129
13,000	126
12,500	125
12,000	123
11,000	121
10,000	118
9000	115

EXAMPLE:

OAT .... -6°C
PRESSURE ALTITUDE .... 18,000 FT
WEIGHT .... 12,391 LBS

RATE OF CLIMB .... 1135 FT/MIN
CLIMB GRADIENT 6.8%
CLIMB SPEED V2 .... 125 KNOTS

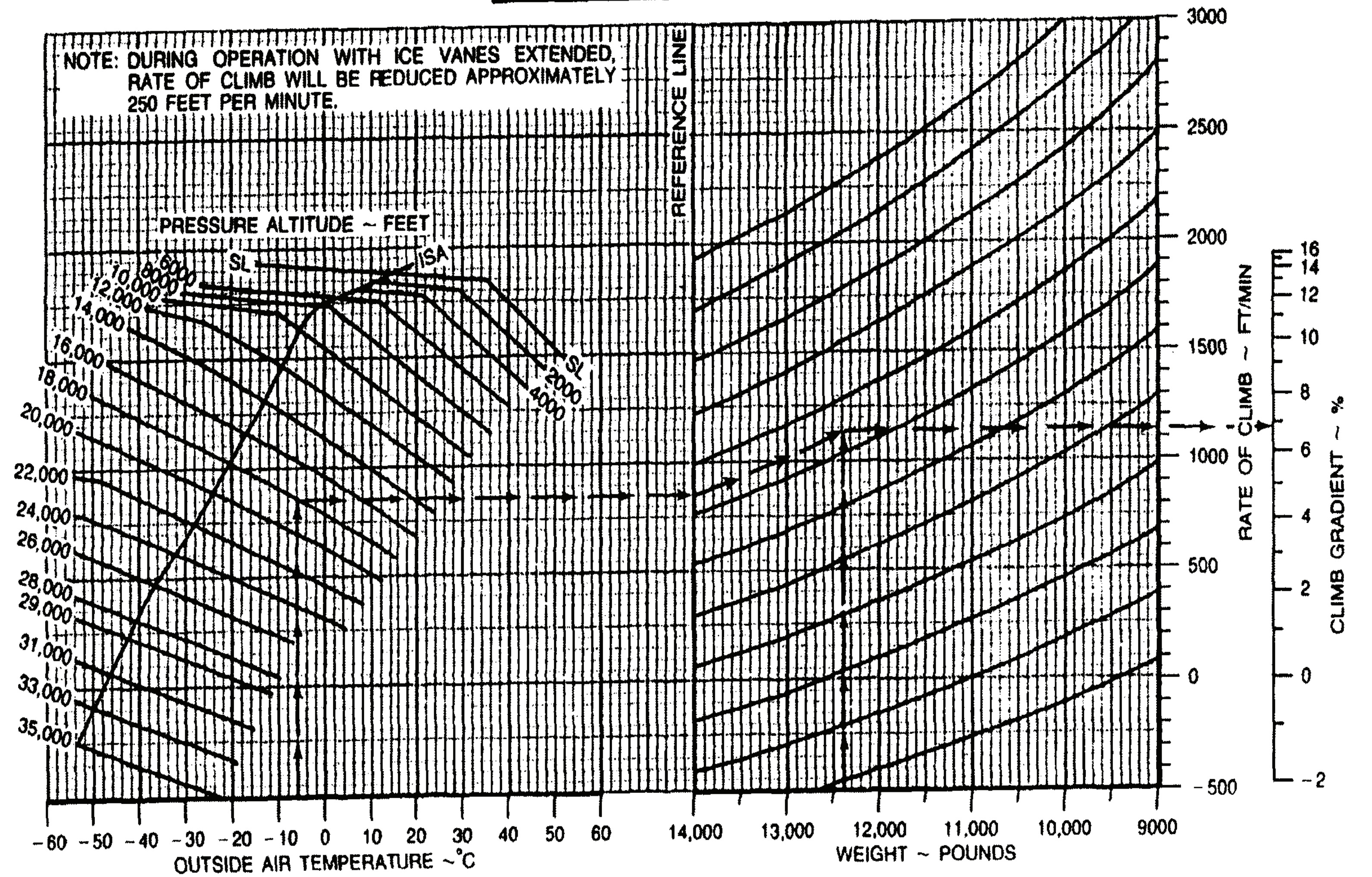


Figure 7-30. Climb – Two Engines, Flaps APPROACH

CLIMB - ONE ENGINE INOPERATIVE

ASSOCIATED CONDITIONS:

POWER .... MAXIMUM CONTINUOUS
FLAPS .... UP
LANDING GEAR .... UP
INOPERATIVE PROPELLER ... FEATHERED

WEIGHT ~ POUNDS	CLIMB SPEED ~ KNOTS
14,000	124
12,500	121
12,000	119
11,000	117
10,000	114
9000	111

EXAMPLE:

OAT .... 30°C
PRESSURE ALTITUDE .... 4,000 FT
D.P CLIMB REQ. .... 250 FT/NM
250/6076 X 100 = 4.1% GRADIENT
CLIMB GRADIENT REQUIRED . . 4.1%

MAXIMUM WT. FOR SE CLB. GD. 12,600 LBS
CLIMB SPEED .... 122 KNOTS

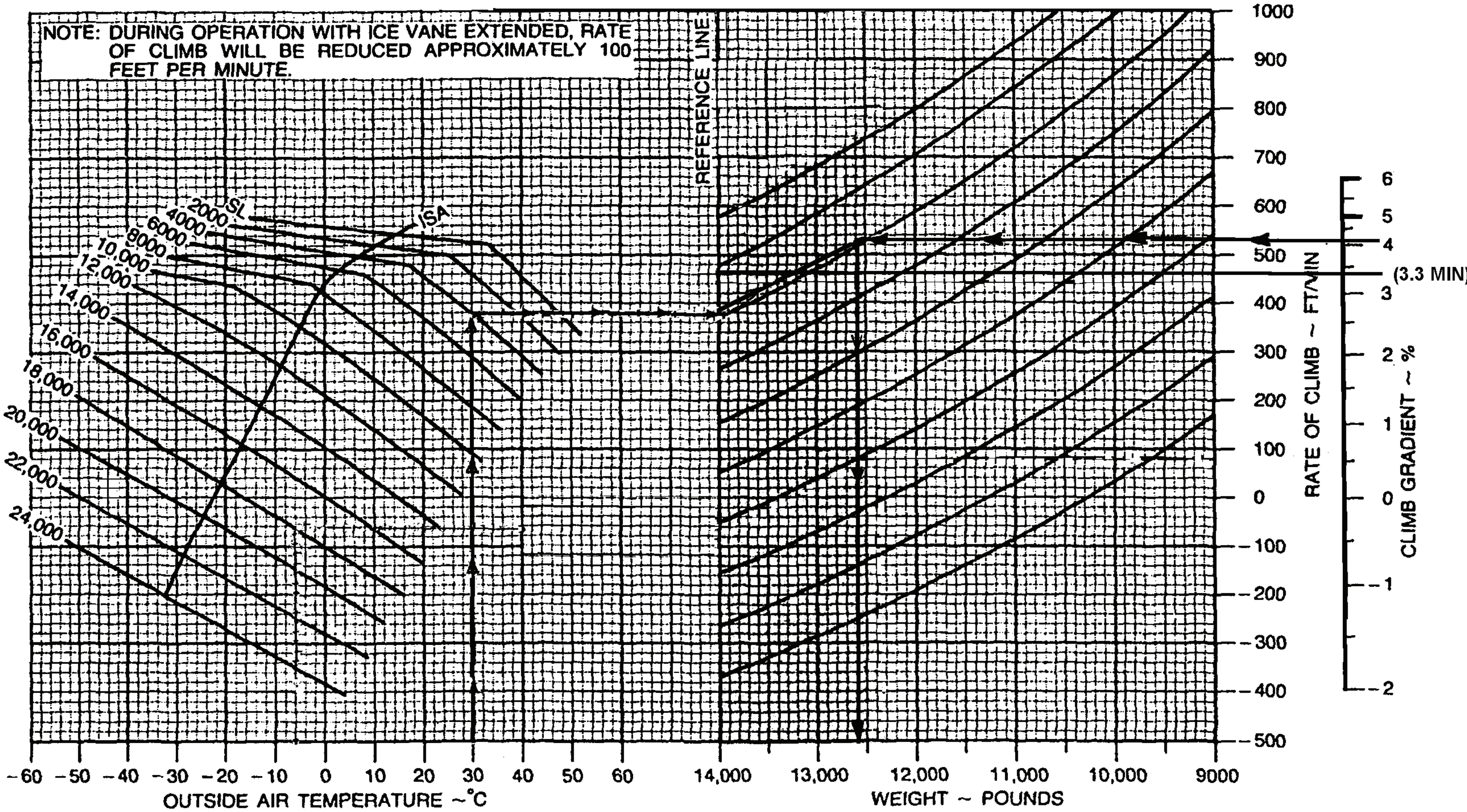


Figure 7-31. Climb – One Engine Inoperative

SERVICE CEILING - ONE ENGINE INOPERATIVE

ASSOCIATED CONDITIONS:

POWER .... MAXIMUM CONTINUOUS
LANDING GEAR .... UP
INOPERATIVE PROPELLER ... FEATHERED
FLAPS .... UP

NOTE: SERVICE CEILING IS THE MAXIMUM PRESSURE ALTITUDE AT WHICH THE AIRPLANE IS CAPABLE OF CLIMBING 50 FT/MINUTE WITH ONE PROPELLER FEATHERED.

EXAMPLE:

OAT AT MEA (WORST LEG) .... 0°C
WEIGHT .... 12,391 LBS
ROUTE SEGMENT MEA .... 18,000 FT

SERVICE CEILING .... 18,100 FT

NOTE: SERVICE CEILING IS ABOVE ENROUTE MEA.

NOTE: DURING OPERATION WITH ICE VANE EXTENDED, SERVICE CEILING WILL BE LOWERED APPROXIMATELY 1500 FEET.

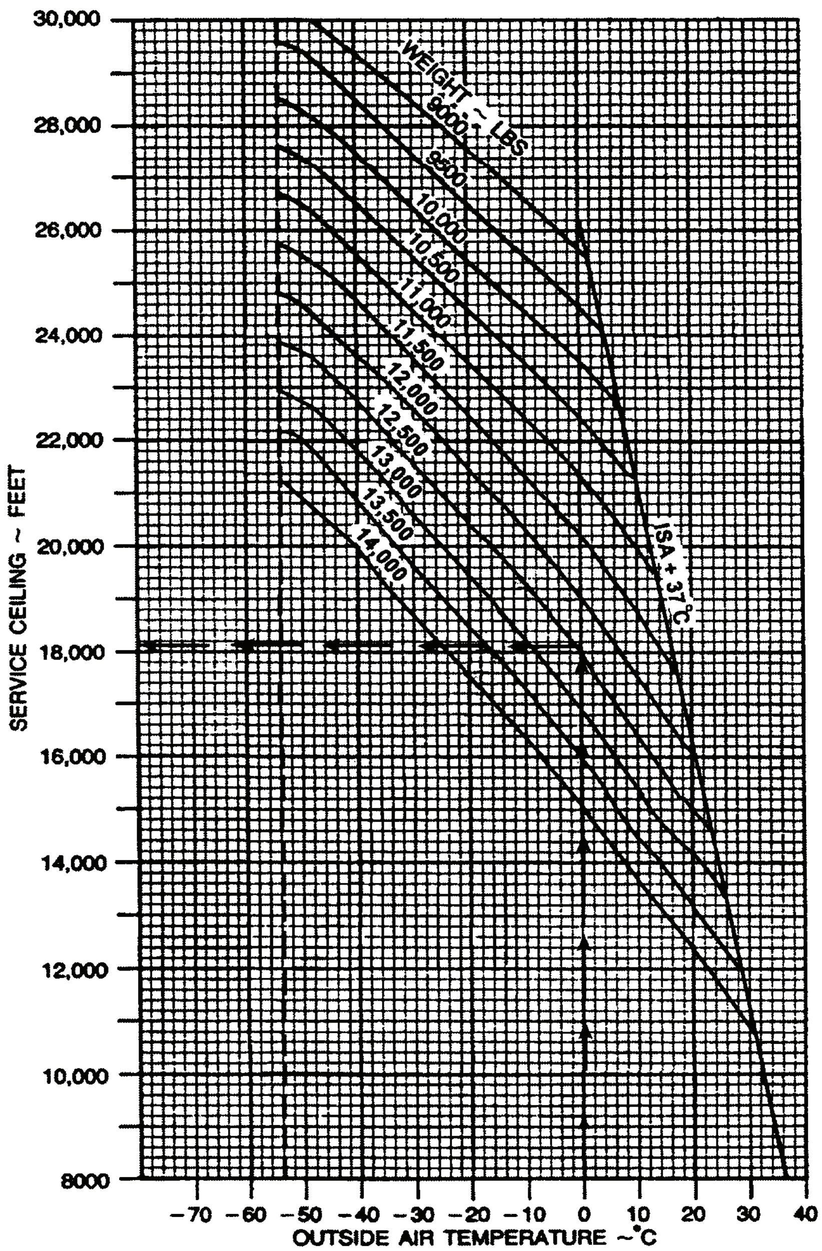


Figure 7-32. Service Ceiling – One Engine Inoperative

TIME, FUEL, AND DISTANCE TO CLIMB

ASSOCIATED CONDITIONS:

PROPELLER SPEED .... 1900 RPM
ITT .... 770°C
OR TORQUE 100%

ALTITUDE ~ FEET	CLIMB SPEED ~ KNOTS
SL TO 10,000	160
10,000 TO 20,000	140
20,000 TO 25,000	130
25,000 TO 35,000	120

NOTE:
1. ADD 90 LBS FUEL FOR START, TAXI, AND TAKEOFF.
2. FOR OPERATION WITH ICE VANES EXTENDED, ADD 20°C TO THE ACTUAL OAT BEFORE ENTERING THE GRAPH.

EXAMPLE:

OAT AT TAKEOFF .... 28°C
OAT AT CRUISE .... −10°C
AIRPORT PRESSURE ALTITUDE ..... 5433 FT
CRUISE ALTITUDE .... 26,000 FT
INITIAL CLIMB WEIGHT .... 12,500 LBS

TIME TO CLIMB (21-3) .... 18 MIN
FUEL TO CLIMB (265-43) .... 222 LBS
DISTANCE TO CLIMB (63-8) .... 55 NM

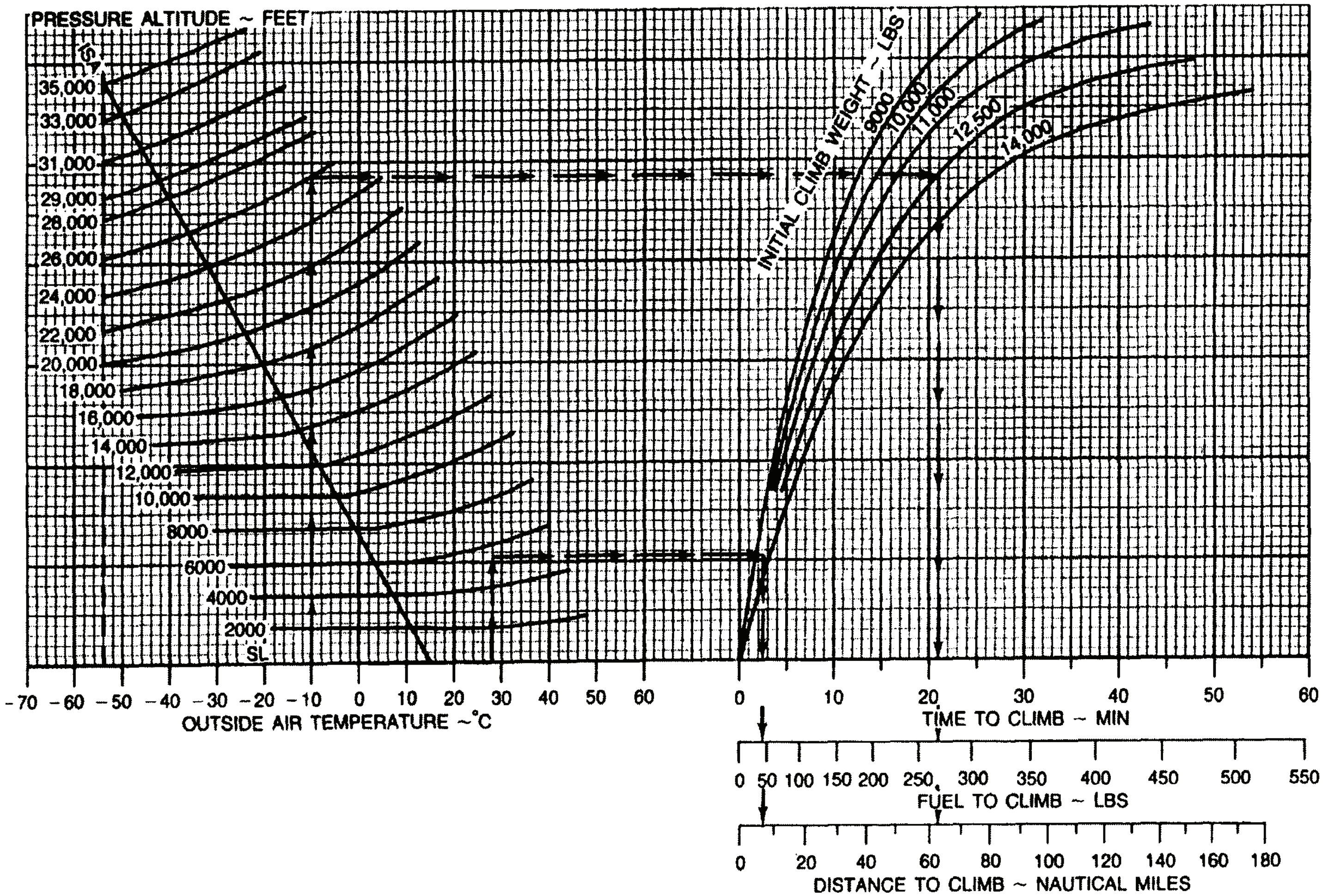


Figure 7-33. Time, Fuel, and Distance to Climb

NORMAL CRUISE POWER
1700 RPM
ISA – 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	2230	100	930	240	228	241	229	242	230	242	231
2000	-14	-19	2230	100	906	237	232	238	233	239	234	240	235
4000	-18	-23	2230	100	882	235	236	236	237	237	238	238	239
6000	-22	-27	2230	100	858	233	241	234	242	235	243	236	244
8000	-25	-31	2230	100	834	231	245	232	246	233	248	234	249
10,000	-29	-35	2230	100	814	228	250	230	251	231	252	231	235
12,000	-33	-39	2230	100	794	226	255	227	256	228	257	229	258
14,000	-36	-43	2230	100	780	224	259	225	261	226	262	227	263
16,000	-40	-47	2230	100	768	221	265	222	266	224	268	225	269
18,000	-44	-51	2230	100	760	219	270	220	271	221	273	222	274
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-34. Normal Cruise Power, 1700 RPM, ISA – 30 °C

NORMAL CRUISE POWER
1700 RPM
ISA – 20 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	2230	100	934	238	231	239	232	240	232	241	233
2000	-4	-9	2230	100	908	236	235	237	236	238	237	239	238
4000	-8	-13	2230	100	880	233	239	234	240	235	241	236	242
6000	-11	-17	2230	100	858	231	244	232	245	233	246	234	247
8000	-15	-21	2230	100	838	229	248	230	250	231	251	232	252
10,000	-19	-25	2230	100	818	226	253	228	254	229	255	230	257
12,000	-23	-29	2230	100	796	224	258	225	259	226	260	227	262
14,000	-26	-33	2230	100	782	222	263	223	264	224	266	225	267
16,000	-30	-37	2230	100	772	219	268	221	270	222	271	223	272
18,000	-34	-41	2230	100	764	216	273	218	275	219	276	220	278
20,000	-37	-45	2230	100	758	213	278	215	280	216	281	218	283
22,000	-41	-49	2141	96	724	207	278	209	281	211	283	212	285
24,000	-45	-53	2007	90	680	199	276	201	279	203	282	205	284
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-35. Normal Cruise Power, 1700 RPM, ISA – 20 °C

NORMAL CRUISE POWER
1700 RPM
ISA – 10 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	10	5	2230	100	940	236	233	237	234	238	235	239	236
2000	6	1	2230	100	914	234	238	235	239	236	240	237	240
4000	3	-3	2230	100	888	232	242	233	243	234	244	235	245
6000	-1	-7	2230	100	862	229	247	231	248	232	249	232	250
8000	-5	-11	2230	100	840	227	251	228	253	229	254	230	255
10,000	-9	-15	2230	100	818	225	256	226	257	227	259	228	260
12,000	-12	-19	2230	100	800	222	261	223	262	225	264	226	265
14,000	-16	-23	2230	100	786	220	266	221	268	222	269	223	270
16,000	-20	-27	2230	100	776	217	271	218	273	220	274	222	276
18,000	-24	-31	2230	100	768	214	276	216	278	217	279	218	281
20,000	-27	-35	2141	96	734	208	276	210	279	211	281	213	283
22,000	-31	-39	2052	92	698	201	276	203	279	205	281	207	284
24,000	-35	-43	1918	86	652	193	274	195	277	197	280	199	283
26,000	-40	-47	1784	80	606	184	270	187	274	189	278	191	281
28,000	-44	-51	1650	74	558	174	265	177	270	180	275	183	278
29,000	-46	-52	1583	71	534	168	261	172	267	176	272	179	277
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-36. Normal Cruise Power, 1700 RPM, ISA – 10 °C

NORMAL CRUISE POWER
1700 RPM
ISA

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	20	15	2230	100	946	235	236	236	237	237	238	238	239
2000	16	11	2230	100	920	232	240	234	241	235	242	235	243
4000	13	7	2230	100	892	230	245	231	246	232	247	233	248
6000	9	3	2230	100	866	228	249	229	251	230	252	231	253
8000	5	-1	2230	100	844	225	254	226	255	228	257	228	258
10,000	1	-5	2230	100	822	223	259	224	260	225	262	226	263
12,000	-2	-9	2230	100	800	220	264	222	266	223	267	224	286
14,000	-6	-13	2230	100	786	218	269	220	271	221	272	222	274
16,000	-10	-17	2230	100	776	215	274	216	276	218	277	219	279
18,000	-14	-21	2141	96	742	208	274	210	276	212	279	213	280
20,000	-18	-25	2052	92	706	202	274	204	277	206	279	207	281
22,000	-21	-29	1940	87	672	195	274	197	277	199	280	201	282
24,000	-26	-33	1829	82	628	187	271	189	275	192	278	194	281
26,000	-30	-37	1695	76	580	177	267	181	272	183	276	186	279
28,000	-34	-41	1561	70	534	167	261	171	267	175	272	177	276
29,000	-36	-42	1494	67	512	161	256	166	264	170	269	173	274
31,000	-40	-46	1360	61	472	149	246	156	256	160	264	164	270
33,000	-45	-50	1249	56	432	– – –	– – –	143	245	150	155	155	265
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-37. Normal Cruise Power, 1700 RPM, ISA

NORMAL CRUISE POWER
1700 RPM
ISA + 10 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	30	25	2230	100	952	233	238	234	239	235	240	236	241
2000	27	21	2230	100	924	231	243	232	244	233	145	234	246
4000	23	17	2230	100	898	229	247	230	249	231	250	232	251
6000	19	13	2230	100	874	226	252	227	253	228	255	229	256
8000	15	9	2230	100	848	224	257	225	258	226	259	227	261
10,000	12	5	2230	100	826	221	262	222	263	224	265	225	266
12,000	8	1	2230	100	804	219	267	220	269	221	270	222	271
14,000	4	-3	2230	100	790	216	272	217	273	219	275	220	276
16,000	0	-7	2163	97	756	210	273	212	275	213	277	215	279
18,000	-4	-11	2052	92	714	203	273	205	275	207	277	208	279
20,000	-8	-15	1962	88	680	197	273	199	276	201	278	202	281
22,000	-12	-19	1851	83	648	189	271	192	275	194	278	196	281
24,000	-16	-23	1739	78	604	181	268	184	273	186	276	189	280
26,000	-20	-27	1606	72	558	171	263	175	269	178	273	180	277
28,000	-24	-31	1472	66	512	160	256	165	263	169	269	172	274
29,000	-26	-32	1405	63	492	154	251	160	259	164	266	167	271
31,000	-31	-36	1293	58	452	139	234	149	251	154	260	158	267
33,000	-36	-40	1160	52	414	– – –	– – –	133	234	143	251	149	261
35,000	-40	-44	1070	48	380	– – –	– – –	– – –	– – –	128	233	138	251

Figure 7-38. Normal Cruise Power, 1700 RPM, ISA + 10 °C

NORMAL CRUISE POWER
1700 RPM
ISA + 20 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	40	35	2230	100	958	323	241	233	242	234	243	235	244
2000	37	31	2230	100	932	229	245	231	247	232	248	233	249
4000	33	27	2230	100	94	227	250	228	251	229	252	230	253
6000	29	23	2230	100	878	225	255	226	256	227	257	228	258
8000	25	19	2230	100	854	222	260	223	261	224	262	225	263
10,000	22	15	2230	100	832	220	265	221	266	222	268	223	269
12,000	18	11	2208	99	806	216	269	218	271	219	272	220	274
14,000	14	7	2219	95	762	210	269	212	271	213	273	215	274
16,000	10	3	2029	91	722	203	269	205	272	207	274	209	276
18,000	6	-1	1940	87	682	197	269	199	272	201	275	202	277
20,000	2	-5	1873	84	654	191	270	194	273	195	276	197	279
22,000	-2	-9	1874	80	624	184	270	187	274	189	277	919	280
24,000	-6	-13	1673	75	582	175	266	179	271	182	275	184	279
26,000	-10	-17	1539	69	536	165	260	170	266	173	271	176	275
28,000	-14	-21	1405	63	492	153	250	159	259	163	265	167	271
29,000	-17	-22	1338	60	472	145	242	153	254	158	262	162	268
31,000	-21	-26	1227	55	432	– – –	– – –	140	242	149	255	153	263
33,000	-25	-30	1115	50	400	– – –	– – –	– – –	– – –	136	243	143	258
35,000	-29	-34	1026	46	368	– – –	– – –	– – –	– – –	– – –	– – –	131	244

Figure 7-39. Normal Cruise Power, 1700 RPM, ISA + 20 °C

NORMAL CRUISE POWER
1700 RPM
ISA + 30 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	2230	100	964	231	243	231	244	232	245	233	246
2000	47	41	2230	100	936	228	248	229	249	230	250	231	251
4000	43	37	2230	100	910	226	252	227	254	228	255	229	256
6000	39	33	2230	100	882	223	257	224	259	225	260	226	261
8000	36	29	2230	100	858	221	262	222	264	223	265	224	266
10,000	32	25	2163	97	818	216	264	217	266	219	268	220	269
12,000	28	21	2074	93	764	209	264	211	266	212	268	214	270
14,000	24	17	1985	89	724	203	265	205	267	206	269	208	271
16,000	20	13	1896	85	686	196	265	198	268	200	270	202	272
18,000	16	9	1806	81	650	190	265	192	268	194	271	197	273
20,000	12	5	1762	79	626	185	266	187	270	189	273	191	276
22,000	8	1	1717	77	602	179	267	182	271	184	275	186	278
24,000	4	-3	1583	71	560	169	262	173	268	176	272	179	276
26,000	0	-7	1472	66	516	159	255	164	262	168	268	171	273
28,000	-4	-11	1338	60	474	147	244	153	255	158	263	162	269
29,000	-7	-12	1293	58	454	137	232	147	250	153	259	157	266
31,000	-12	-16	1160	52	414	– – –	– – –	131	231	142	250	148	260
33,000	-16	-20	1048	47	382	– – –	– – –	– – –	– – –	126	230	137	251
35,000	-20	-24	959	43	350	– – –	– – –	– – –	– – –	– – –	– – –	121	230

Figure 7-40. Normal Cruise Power, 1700 RPM, ISA + 30 °C

NORMAL CRUISE POWER
1700 RPM
ISA + 37 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	2230	100	968	229	245	231	246	232	247	232	248
2000	54	48	2230	100	940	227	249	228	251	229	252	230	253
4000	50	44	2230	100	912	225	254	226	255	227	257	228	258
6000	46	40	2230	100	886	222	259	223	260	224	262	225	263
8000	42	36	2141	96	838	216	260	218	262	219	263	220	265
10,000	39	32	2074	93	790	210	261	212	263	214	265	215	267
12,000	35	28	1962	88	738	204	261	205	263	207	265	209	267
14,000	31	24	1873	84	700	197	261	200	264	201	266	203	268
16,000	27	20	1806	81	664	191	261	194	265	196	267	198	270
18,000	23	16	1695	76	630	185	261	188	265	190	268	192	271
20,000	19	12	1695	76	606	180	263	183	267	185	270	187	273
22,000	15	8	1628	73	582	174	263	177	268	180	272	182	275
24,000	11	4	1539	69	542	165	258	169	264	172	270	175	274
26,000	7	0	1405	63	500	154	251	160	259	164	266	167	271
28,000	2	-4	1293	58	460	140	237	149	251	154	260	158	266
29,000	0	-5	1227	55	440	– – –	– – –	142	244	149	256	154	263
31,000	-4	-9	1137	51	406	– – –	– – –	– – –	– – –	137	245	144	257
33,000	-8	-13	1048	47	376	– – –	– – –	– – –	– – –	– – –	– – –	133	246
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-41. Normal Cruise Power, 1700 RPM, ISA + 37 °C

NORMAL CRUISE SPEEDS

1700 RPM

WEIGHT 12,000 LBS

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 30 KNOTS IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, BUT WILL BE UNCHANGED IF THE ORIGINAL POWER IS RESET.

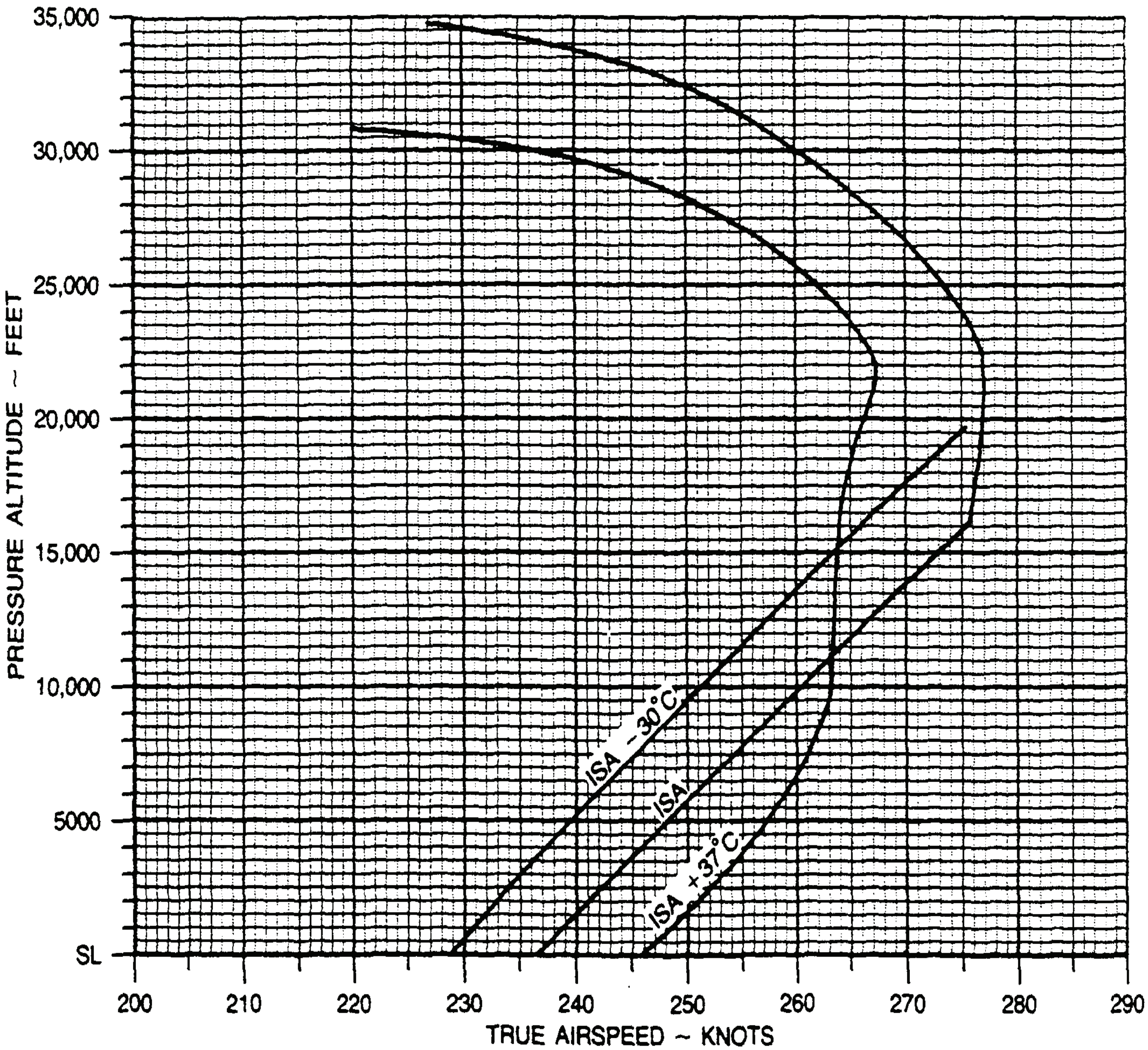


Figure 7-42. Normal Cruise Speeds, 1700 RPM

NORMAL CRUISE POWER

1700 RPM

NOTES: 1. DURING OPERATION WITH ICE VANES EXTENDED TORQUE WILL DECREASE APPROXIMATELY 20%.

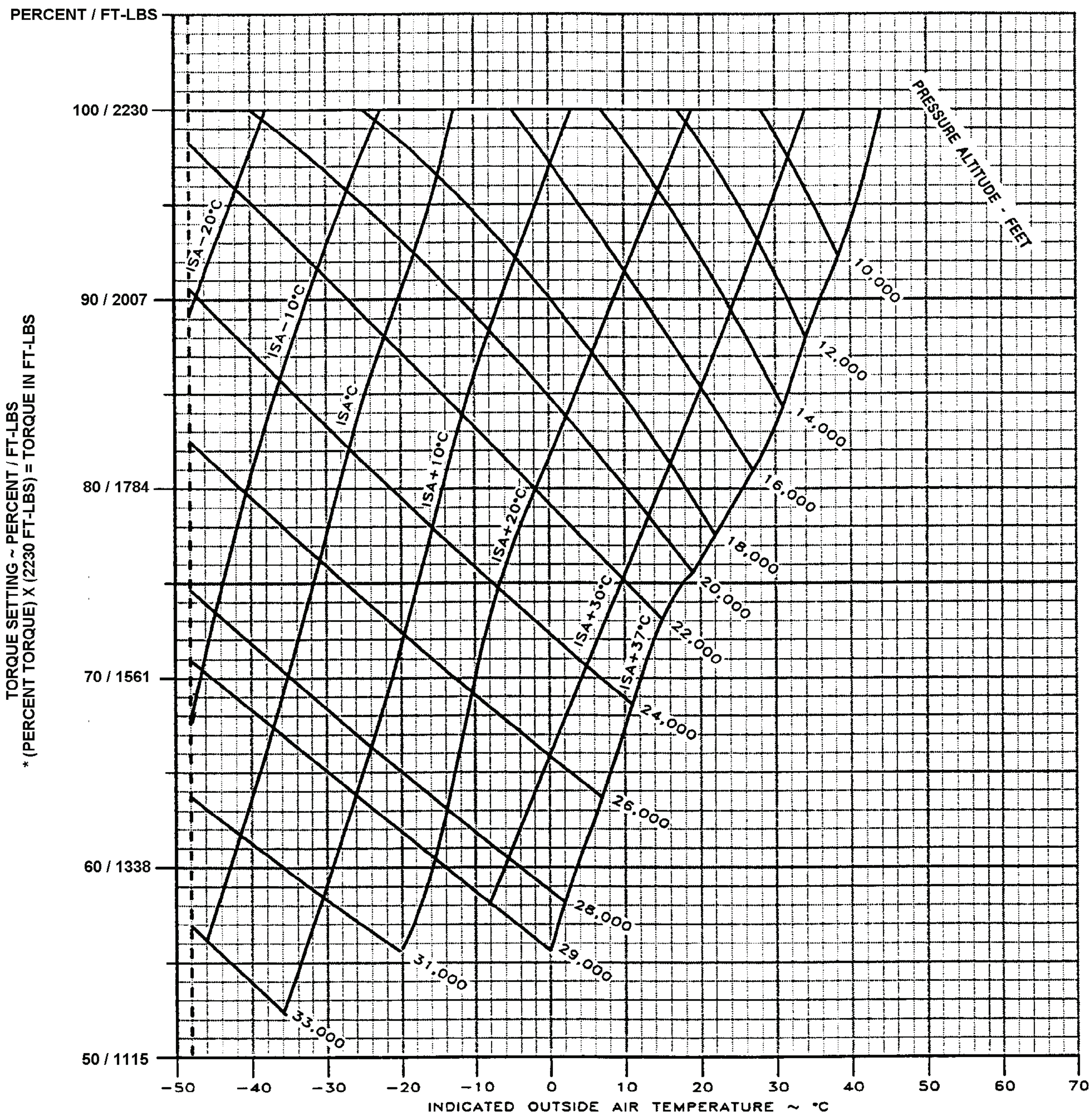


Figure 7-43. Normal Cruise Power, 1700 RPM

FUEL FLOW AT NORMAL CRUISE POWER

1700 RPM

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, FUEL FLOW WILL DECREASE APPROXIMATELY 10% IF ORIGINAL POWER IS NOT OR CANNOT BE RESET. IF ORIGINAL POWER IS RESET, FUEL FLOW WILL INCREASE APPROXIMATELY 30 LBS/HR/ENG.

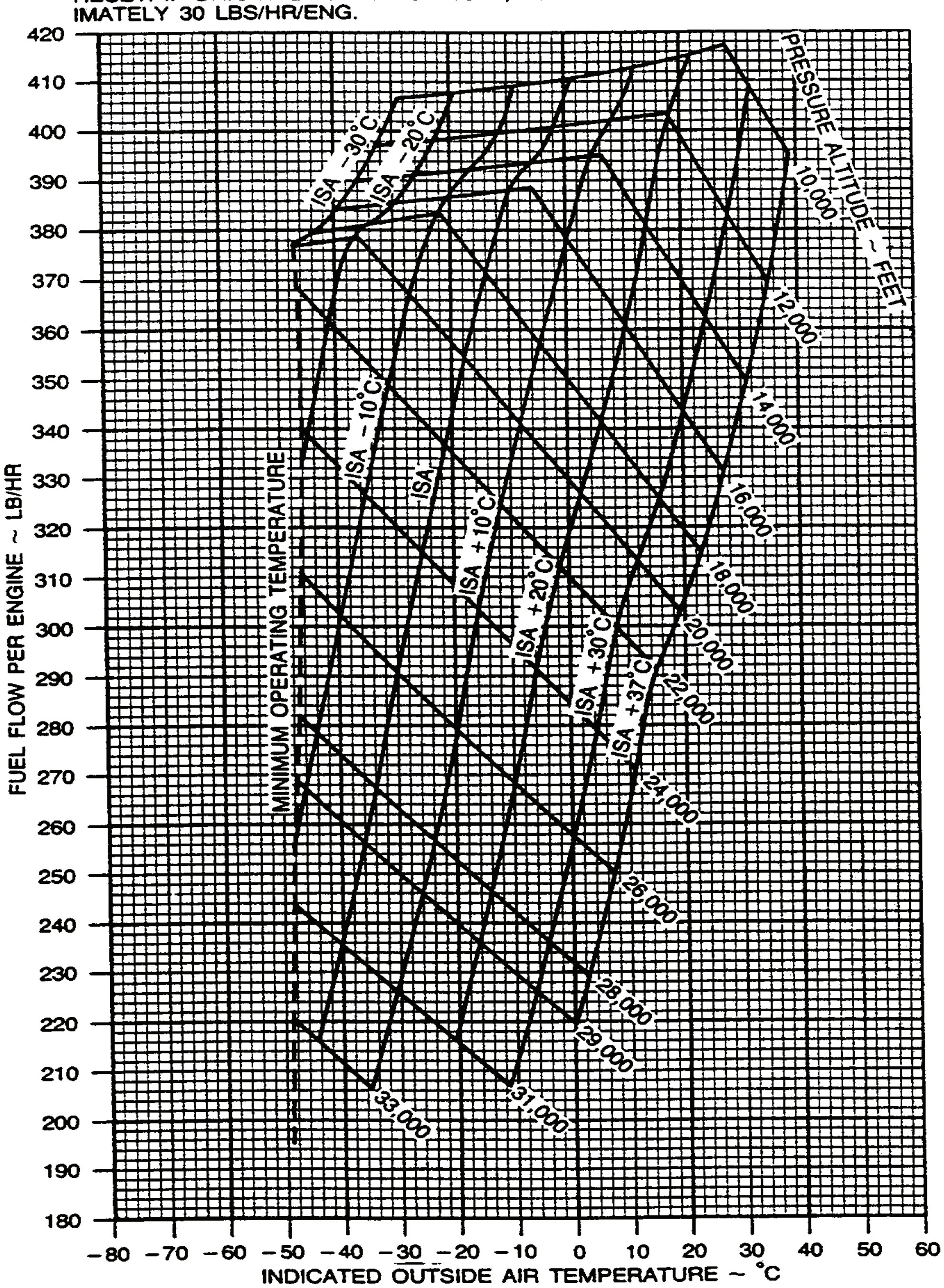


Figure 7-44. Fuel Flow At Normal Cruise Power, 1700 RPM

RANGE PROFILE - NORMAL CRUISE POWER

1700 RPM

STANDARD DAY (ISA)
ZERO WIND

ASSOCIATED CONDITIONS:

WEIGHT	14,090 LBS BEFORE ENGINE START
FUEL	AVIATION KEROSENE
FUEL DENSITY	6.7 LBS /GAL
ICE VANES	RETRACTED

EXAMPLE:

PRESSURE ALTITUDE	26,000 FT
FUEL USED	2586 LBS
RANGE	977 NM

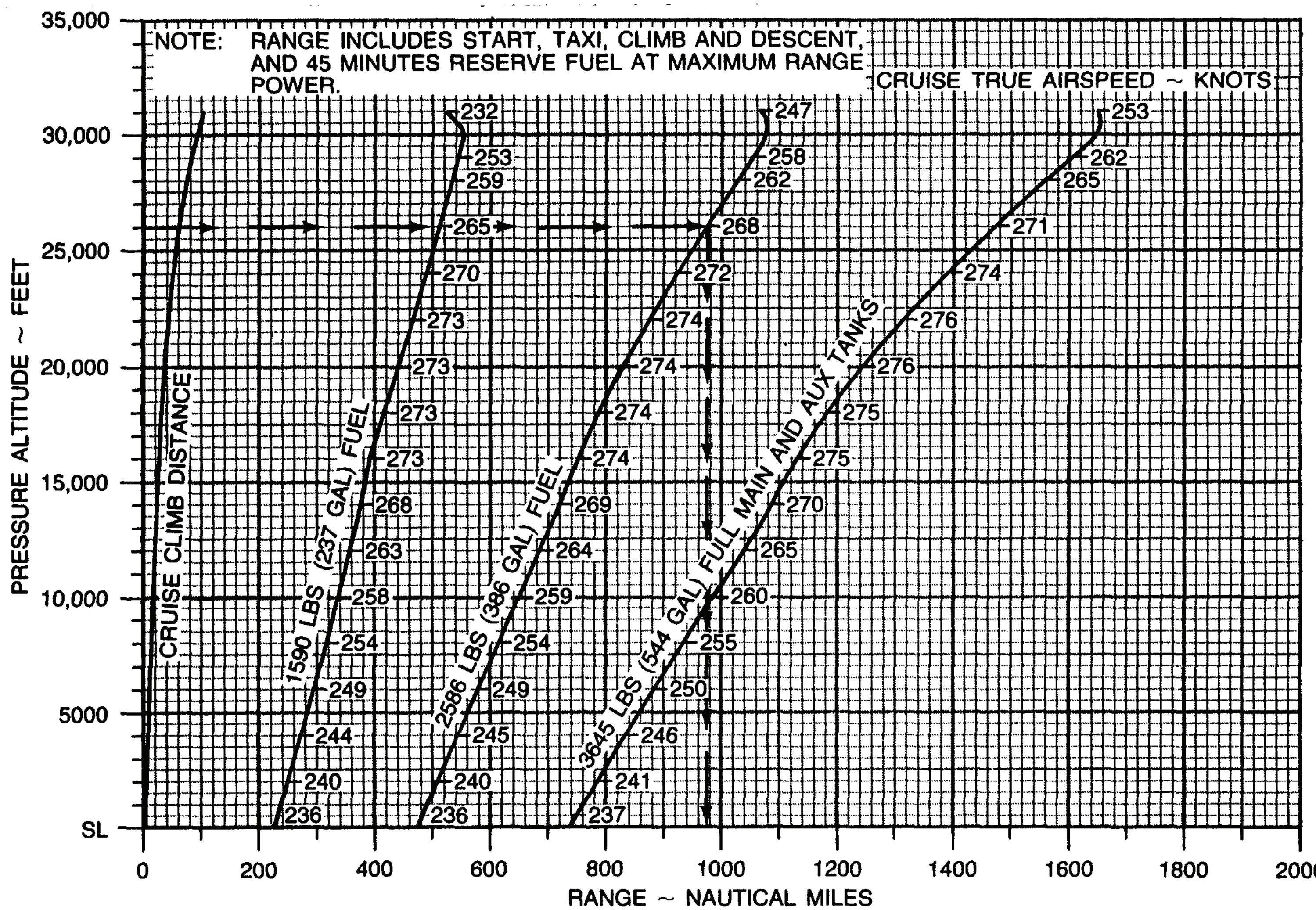


Figure 7-45. Range Profile – Normal Cruise Power, 1700 RPM

MAXIMUM CRUISE POWER
1700 RPM
ISA – 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	2230	100	930	240	228	241	229	242	230	242	231
2000	-14	-19	2230	100	906	237	232	238	233	239	234	240	235
4000	-18	-23	2230	100	882	235	236	236	237	237	238	238	239
6000	-22	-27	2230	100	858	233	241	234	242	235	243	236	244
8000	-25	-31	2230	100	834	231	245	232	246	233	248	234	249
10,000	-29	-35	2230	100	814	228	250	230	251	231	252	231	235
12,000	-33	-39	2230	100	794	226	255	227	256	228	257	229	258
14,000	-36	-43	2230	100	780	224	259	225	261	226	262	227	263
16,000	-40	-47	2230	100	768	221	265	222	266	224	268	225	269
18,000	-44	-51	2230	100	760	219	270	220	271	221	273	222	274
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-46. Maximum Cruise Power, 1700 RPM, ISA – 30 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA – 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	2230	100	934	238	231	239	232	240	232	241	233
2000	-4	-9	2230	100	908	236	235	237	236	238	237	239	238
4000	-8	-13	2230	100	880	233	239	234	240	235	241	236	242
6000	-11	-17	2230	100	858	231	244	232	245	233	246	234	247
8000	-15	-21	2230	100	838	229	248	230	250	231	251	232	252
10,000	-19	-25	2230	100	818	226	253	228	254	229	225	230	257
12,000	-23	-29	2230	100	796	224	258	225	259	226	260	227	262
14,000	-26	-33	2230	100	782	222	263	223	264	224	266	225	267
16,000	-30	-37	2230	100	772	220	268	221	270	222	271	223	272
18,000	-34	-41	2230	100	764	216	273	218	275	219	276	220	278
20,000	-37	-45	2230	100	758	213	278	215	280	216	281	218	283
22,000	-41	-49	2230	100	752	210	283	212	285	214	287	215	288
24,000	-45	-53	2096	94	704	202	280	204	283	206	286	208	288
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-47. Maximum Cruise Power, 1700 RPM, ISA – 20 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA – 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	10	5	2230	100	940	236	233	237	234	238	235	239	236
2000	6	1	2230	100	914	234	238	235	239	236	240	237	240
4000	3	-3	2230	100	888	232	242	233	243	234	244	235	245
6000	-1	-7	2230	100	862	229	247	231	248	232	249	232	250
8000	-5	-11	2230	100	840	227	251	228	253	229	254	230	255
10,000	-9	-15	2230	100	818	225	256	226	257	227	259	228	260
12,000	-12	-19	2230	100	800	222	261	223	262	225	264	226	265
14,000	-16	-23	2230	100	786	220	266	221	268	222	269	223	270
16,000	-20	-27	2230	100	776	217	271	218	273	220	274	221	276
18,000	-24	-31	2230	100	768	214	276	216	278	217	279	218	281
20,000	-27	-35	2230	100	762	211	281	213	283	214	285	215	286
22,000	-31	-39	2119	95	724	204	280	206	283	208	286	210	288
24,000	-35	-43	2007	90	680	196	279	199	282	201	285	202	287
26,000	-40	-47	1851	83	630	187	275	190	279	192	283	195	286
28,000	-44	-51	1717	77	580	177	270	181	275	184	279	186	283
29,000	-46	-52	1628	73	556	172	266	175	272	179	277	181	281
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-48. Maximum Cruise Power, 1700 RPM, ISA – 10 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	20	15	2230	100	946	235	236	236	237	237	238	238	239
2000	16	11	2230	100	920	232	240	234	241	235	242	235	243
4000	13	7	2230	100	892	230	245	231	246	232	247	233	248
6000	9	3	2230	100	866	228	249	229	251	230	252	231	253
8000	5	-1	2230	100	844	225	254	226	255	228	257	228	258
10,000	1	-5	2230	100	822	223	259	224	260	225	262	226	263
12,000	-2	-9	2230	100	800	220	264	222	266	223	267	224	286
14,000	-6	-13	2230	100	786	218	269	219	271	221	272	222	274
16,000	-10	-17	2230	100	776	215	274	216	276	218	277	219	279
18,000	-13	-21	2230	100	772	212	278	213	281	215	282	217	284
20,000	-17	-25	2141	96	734	205	279	207	281	209	283	210	285
22,000	-21	-29	2029	91	698	199	274	200	281	202	284	204	286
24,000	-25	-33	1896	85	652	191	276	193	280	195	283	197	286
26,000	-29	-37	1762	79	604	181	272	184	277	187	280	189	284
28,000	-34	-41	1628	73	558	171	266	175	272	178	277	181	281
29,000	-36	-42	1561	70	536	166	263	170	269	173	275	176	279
31,000	-40	-46	1427	64	494	154	253	159	262	164	270	167	275
33,000	-45	-50	1316	59	452	137	235	148	253	154	262	158	270
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-49. Maximum Cruise Power, 1700 RPM, ISA

MAXIMUM CRUISE POWER
1700 RPM
ISA + 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	30	25	2230	100	952	233	238	234	239	235	240	236	241
2000	27	21	2230	100	924	231	243	232	244	233	145	234	246
4000	23	17	2230	100	898	229	247	230	249	231	250	232	251
6000	19	13	2230	100	874	226	252	227	253	228	255	229	256
8000	15	9	2230	100	848	224	257	225	258	226	259	227	261
10,000	12	5	2230	100	826	221	262	222	263	224	265	225	266
12,000	8	1	2230	100	804	219	267	220	269	221	270	222	271
14,000	4	-3	2230	100	790	216	272	217	273	219	275	220	276
16,000	0	-7	2230	100	778	213	277	214	278	216	280	217	282
18,000	-3	-11	2141	96	740	206	277	209	279	210	281	211	283
20,000	-7	-15	2052	92	706	200	277	202	280	204	282	205	285
22,000	-11	-19	1940	87	672	192	276	195	279	197	282	199	285
24,000	-15	-23	1806	81	628	184	273	187	277	189	281	191	284
26,000	-20	-27	1695	76	580	175	268	178	274	181	278	184	282
28,000	-24	-31	1561	70	536	164	262	169	269	172	274	175	279
29,000	-26	-32	1494	67	514	158	257	163	265	167	271	171	277
31,000	-30	-36	1360	61	474	145	245	153	257	158	265	162	272
33,000	-35	-40	1249	56	434	– – –	– – –	140	245	148	258	153	267
35,000	-41	-44	1093	49	388	– – –	– – –	– – –	– – –	134	245	142	259

Figure 7-50. Maximum Cruise Power, 1700 RPM, ISA + 10 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA + 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	40	35	2230	100	958	323	241	233	242	234	243	235	244
2000	37	31	2230	100	932	229	245	231	247	232	248	233	249
4000	33	27	2230	100	904	229	250	228	251	229	252	230	253
6000	29	23	2230	100	878	225	255	226	256	227	257	228	258
8000	25	19	2230	100	854	222	260	223	261	224	262	225	263
10,000	22	15	2230	100	832	220	265	221	266	222	268	223	269
12,000	18	11	2230	100	810	217	270	218	271	220	273	221	274
14,000	14	7	2185	98	780	212	272	214	274	215	276	217	278
16,000	10	3	2096	94	744	206	273	208	275	210	278	211	279
18,000	6	-1	2029	91	708	200	274	202	276	204	279	206	281
20,000	3	-5	1940	87	678	194	274	196	277	198	280	200	283
22,000	-1	-9	1851	83	646	187	274	190	278	192	281	995	284
24,000	-6	-13	1739	78	604	179	271	182	275	185	279	187	283
26,000	-10	-17	1606	72	558	169	265	173	271	176	276	179	280
28,000	-14	-21	1472	66	514	157	257	162	264	167	271	170	276
29,000	-16	-22	1338	60	472	151	251	157	260	162	268	165	273
31,000	-21	-26	1227	55	434	133	230	146	251	152	261	156	269
33,000	-26	-30	1093	49	392	– – –	– – –	128	229	141	252	147	262
35,000	-29	-34	1026	46	368	– – –	– – –	– – –	– – –	– – –	– – –	136	252

Figure 7-51. Maximum Cruise Power, 1700 RPM, ISA + 20 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA + 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	2230	100	964	231	243	231	244	232	245	233	246
2000	47	41	2230	100	936	228	248	229	249	230	250	231	251
4000	43	37	2230	100	910	226	252	227	254	228	255	229	256
6000	39	33	2230	100	882	223	257	224	259	225	260	226	261
8000	36	29	2230	100	858	221	262	222	264	223	265	224	266
10,000	32	25	2208	99	830	216	266	219	268	220	270	221	271
12,000	28	21	2096	94	774	210	266	212	268	213	270	215	271
14,000	24	17	2029	91	740	205	267	206	269	208	272	210	273
16,000	20	13	1962	88	706	199	268	201	271	203	273	204	275
18,000	16	9	1896	85	674	193	269	195	272	197	275	199	277
20,000	12	5	1851	83	650	188	271	190	274	193	277	194	288
22,000	8	1	1762	79	620	181	271	184	275	187	278	189	281
24,000	4	-3	1650	74	580	173	267	176	272	179	276	182	280
26,000	0	-7	1539	69	536	163	261	167	267	171	273	174	278
28,000	-4	-11	1405	63	494	151	252	157	261	162	268	165	274
29,000	-7	-12	1360	61	474	144	244	151	257	157	265	161	272
31,000	-11	-16	1227	55	434	– – –	– – –	138	243	146	257	151	266
33,000	-15	-20	1137	51	402	– – –	– – –	– – –	– – –	133	243	141	258
35,000	-19	-24	1026	46	370	– – –	– – –	– – –	– – –	– – –	– – –	128	243

Figure 7-52. Maximum Cruise Power, 1700 RPM, ISA + 30 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA + 37 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	2230	100	968	229	245	231	246	232	247	232	248
2000	54	48	2230	100	940	227	249	228	251	229	252	230	253
4000	50	44	2230	100	912	225	254	226	255	227	257	228	258
6000	46	40	2230	100	886	222	259	223	260	224	262	225	263
8000	43	36	2185	98	846	217	261	219	263	220	265	221	266
10,000	39	32	2096	94	798	211	262	213	264	215	266	216	268
12,000	35	28	1985	89	744	204	262	206	264	208	266	209	268
14,000	31	24	1918	86	712	200	264	201	266	203	269	205	270
16,000	27	20	1873	84	680	194	265	196	268	198	270	200	273
18,000	23	16	1806	81	650	188	266	191	269	193	271	195	275
20,000	19	12	1762	79	628	183	267	186	271	188	274	190	277
22,000	15	8	1695	76	602	177	267	180	272	183	276	185	279
24,000	11	4	1583	71	562	168	263	172	269	175	274	178	278
26,000	7	0	1472	66	520	158	257	163	264	167	270	170	276
28,000	3	-4	1360	61	478	146	246	153	257	157	265	162	272
29,000	0	-5	1293	58	458	136	234	147	252	152	261	157	2669
31,000	-5	-9	1182	53	420	– – –	– – –	134	234	142	253	148	263
33,000	-9	-13	1093	49	390	– – –	– – –	– – –	– – –	127	236	137	254
35,000	-13	-17	1004	45	358	– – –	– – –	– – –	– – –	– – –	– – –	123	237

Figure 7-53. Maximum Cruise Power, 1700 RPM, ISA + 37 °C

MAXIMUM CRUISE SPEEDS

1700 RPM

WEIGHT 12,000 LBS

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 30 KNOTS IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, BUT WILL BE UNCHANGED IF THE ORIGINAL POWER IS RESET.

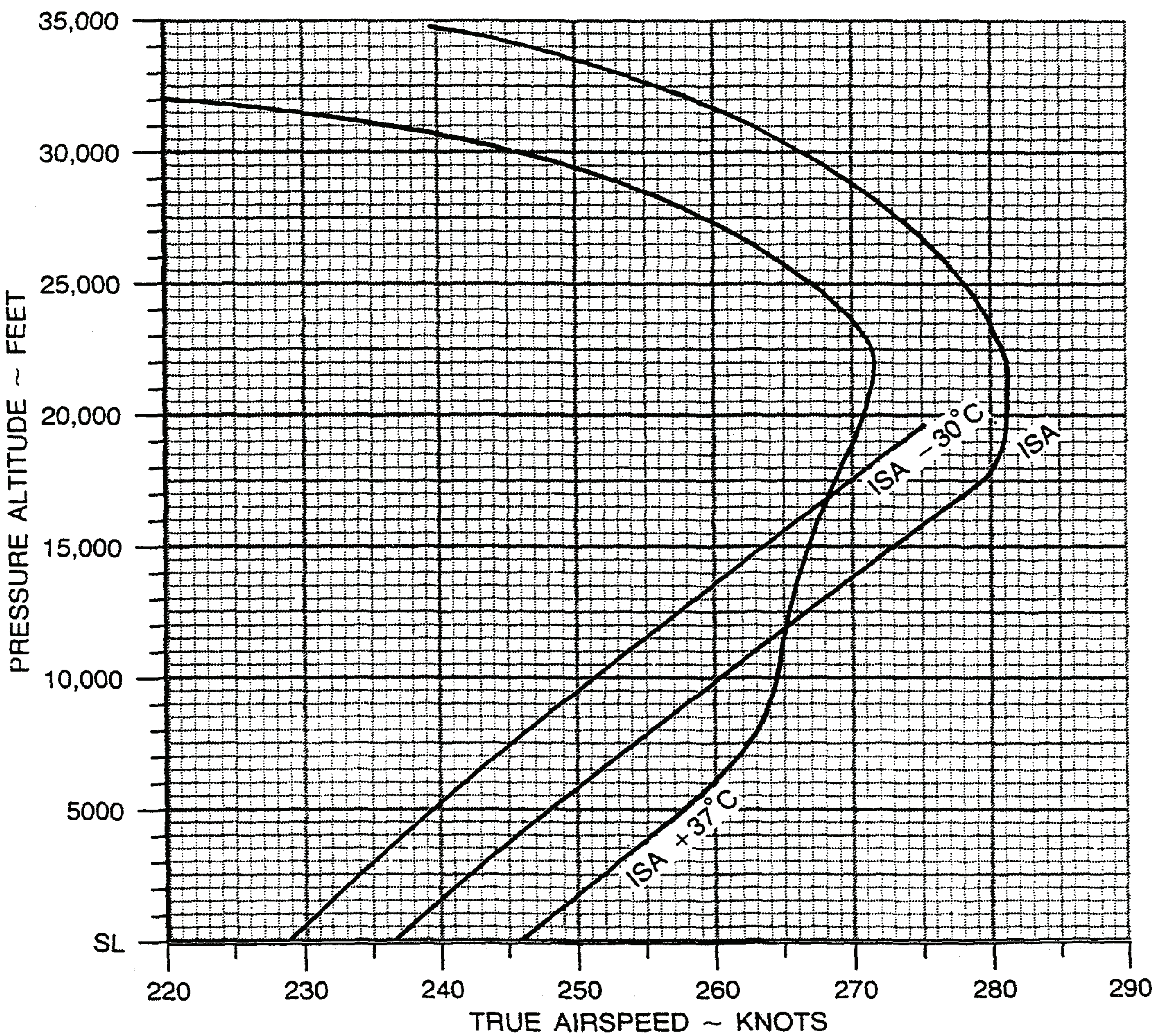


Figure 7-54. Maximum Cruise Speeds, 1700 RPM

MAXIMUM CRUISE POWER

1700 RPM

NOTES: 1. DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE APPROXIMATELY 20%. IF DESIRED, ORIGINAL POWER MAY BE RESET, PROVIDED ITT LIMIT IS NOT EXCEEDED

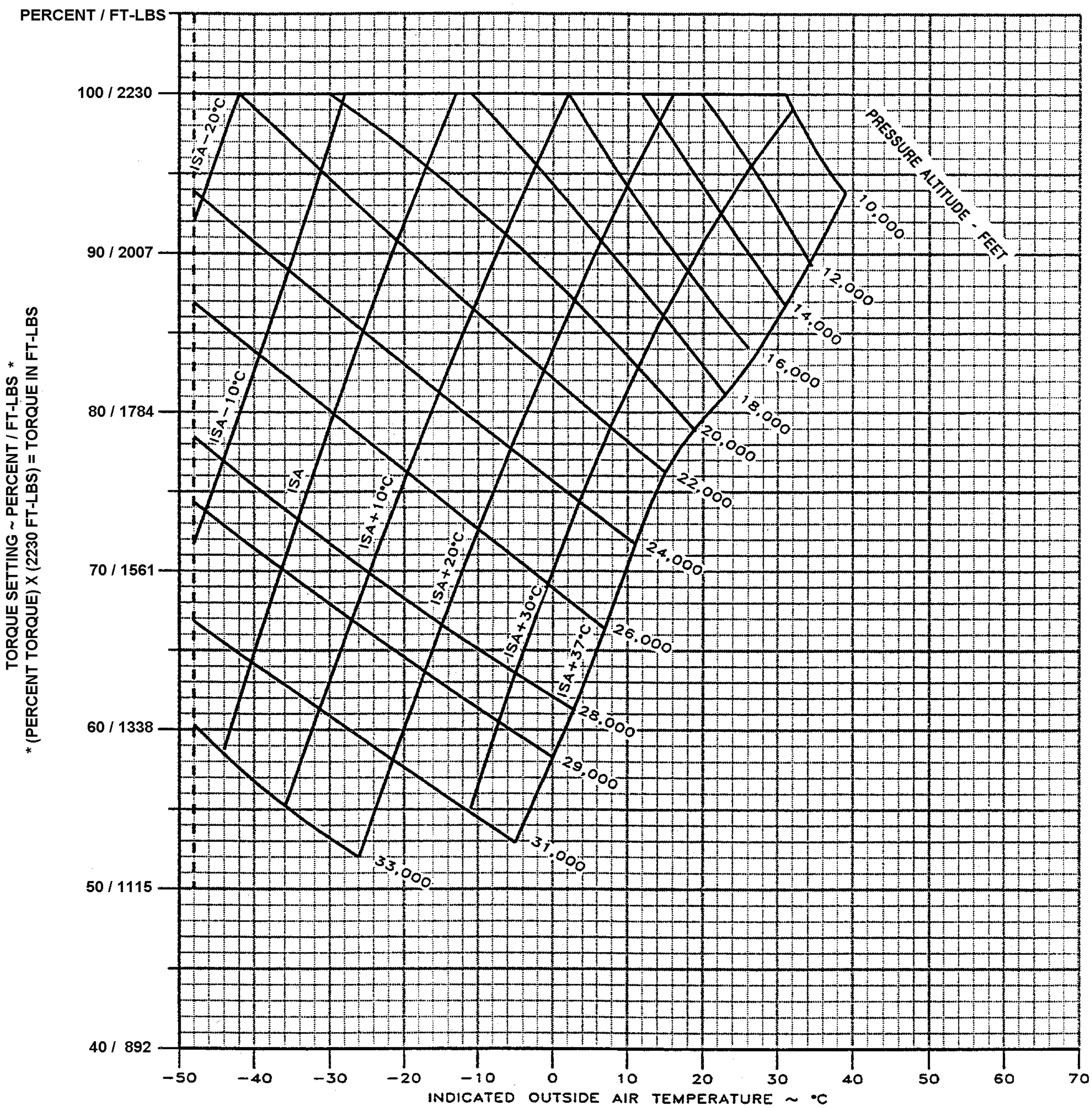


Figure 7-55. Maximum Cruise Power, 1700 RPM

FUEL FLOW AT MAXIMUM CRUISE POWER

1700 RPM

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, FUEL FLOW WILL DECREASE APPROXIMATELY 10% IF ORIGINAL POWER IS NOT OR CANNOT BE RESET. IF ORIGINAL POWER IS RESET, FUEL FLOW WILL INCREASE APPROXIMATELY 30 LBS/HR/ENG.

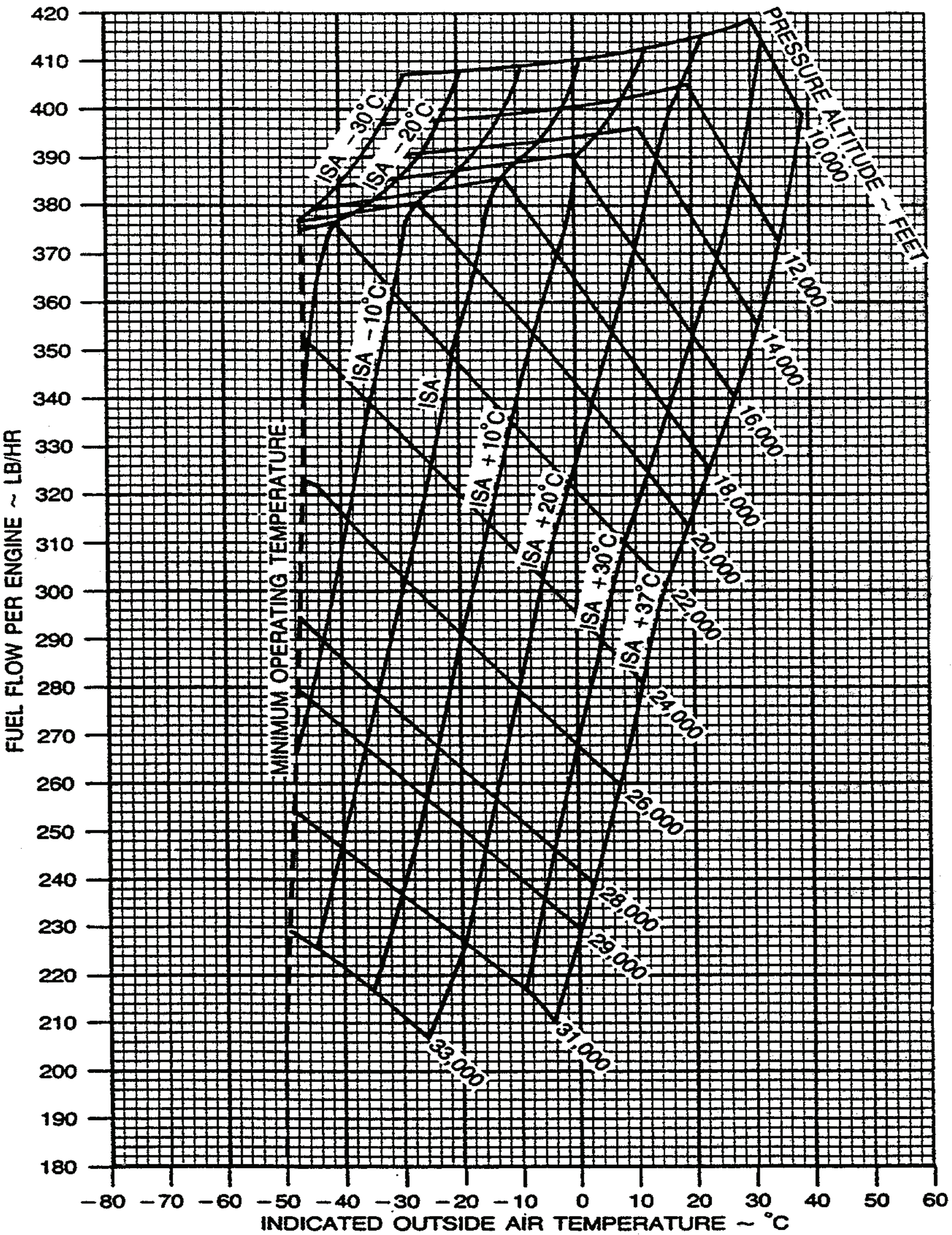


Figure 7-56. Fuel Flow At Maximum Cruise Power, 1700 RPM

RANGE PROFILE - MAXIMUM CRUISE POWER

1700 RPM

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

STANDARD DAY (ISA)
ZERO WIND

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT
FUEL USED .... 2586 LBS

RANGE .... 960 NM

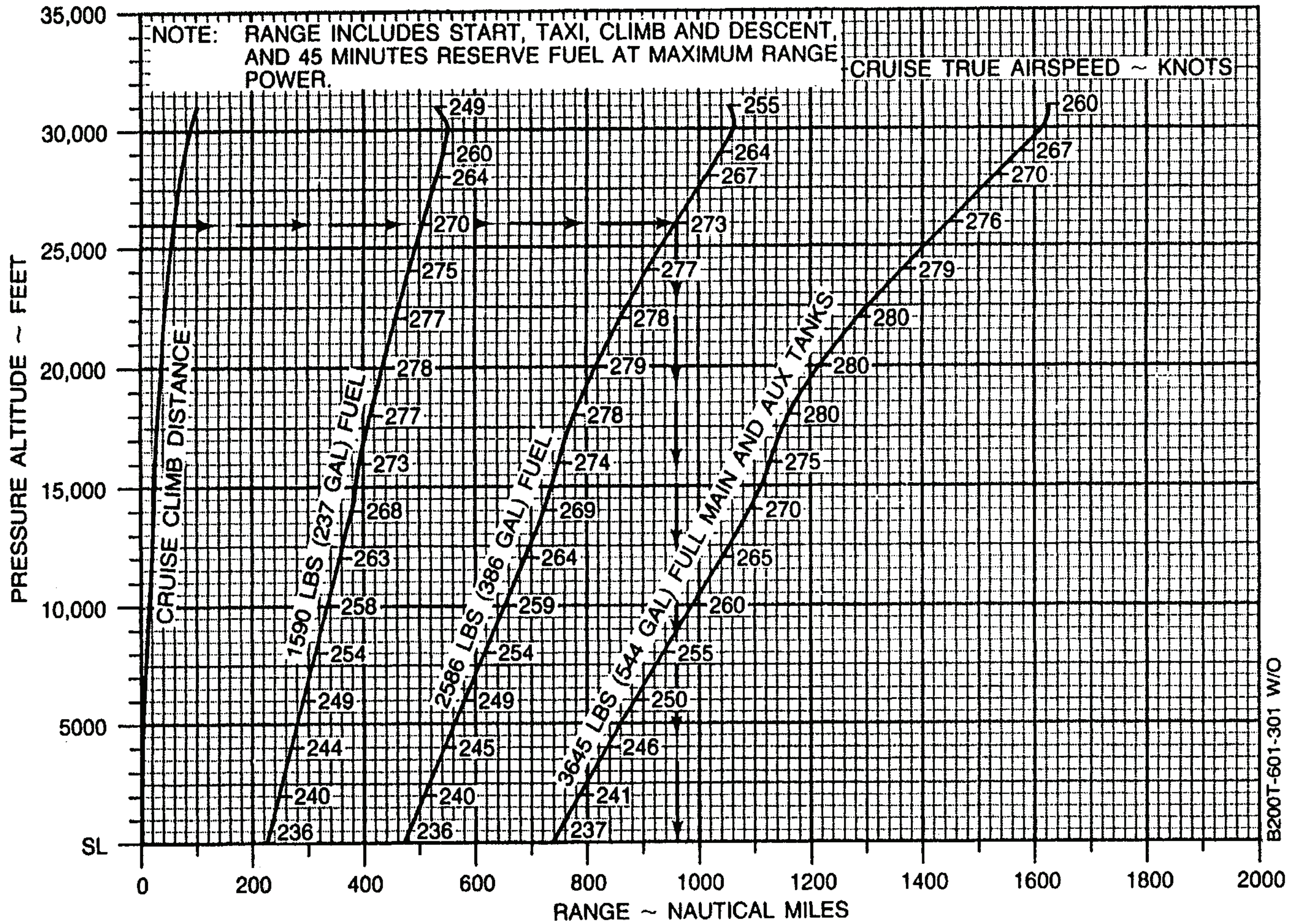


Figure 7-57. Range Profile – Maximum Cruise Power, 1700 RPM

NORMAL CRUISE POWER
1800 RPM
ISA – 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	2185	98	962	244	232	244	232	244	232	244	232
2000	-14	-19	2230	100	946	243	237	244	238	244	238	244	238
4000	-18	-23	2230	100	920	241	242	241	243	242	243	243	244
6000	-21	-27	2230	100	896	238	246	239	247	240	248	241	249
8000	-25	-31	2230	100	874	236	251	237	252	238	253	239	254
10,000	-29	-35	2230	100	854	233	255	235	257	236	258	236	259
12,000	-32	-39	2230	100	834	231	260	232	262	233	263	234	264
14,000	-36	-43	2230	100	820	229	266	230	267	231	268	232	269
16,000	-40	-47	2230	100	808	226	271	228	272	229	273	230	275
18,000	-44	-51	2230	100	798	224	276	225	278	226	279	228	280
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-58. Normal Cruise Power, 1800 RPM, ISA – 30 °C

NORMAL CRUISE POWER
1800 RPM
ISA – 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	2230	100	972	243	236	244	236	244	236	244	236
2000	-4	-9	2230	100	948	241	240	242	241	243	242	244	243
4000	-7	-13	2230	100	922	239	245	240	246	241	246	241	247
6000	-11	-17	2230	100	898	236	249	237	250	238	251	239	252
8000	-15	-21	2230	100	876	234	254	235	255	236	256	237	257
10,000	-19	-25	2230	100	856	232	259	233	260	234	261	235	262
12,000	-22	-29	2230	100	834	229	264	230	265	231	266	232	267
14,000	-26	-33	2230	100	822	227	269	228	270	230	272	230	273
16,000	-30	-37	2230	100	810	224	274	226	276	227	277	228	278
18,000	-33	-41	2230	100	800	222	280	223	281	225	283	226	284
20,000	-37	-45	2141	96	764	216	281	217	283	219	285	220	286
22,000	-41	-49	2052	92	726	209	281	211	283	213	285	214	287
24,000	-45	-53	1918	86	680	201	279	203	282	205	285	207	287
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-59. Normal Cruise Power, 1800 RPM, ISA – 20 °C

NORMAL CRUISE POWER
1800 RPM
ISA – 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	10	5	2230	100	978	242	238	243	239	243	240	244	241
2000	7	1	2230	100	950	239	243	240	244	241	245	242	246
4000	3	-3	2230	100	926	237	247	238	248	239	249	240	250
6000	-1	-7	2230	100	900	234	252	236	253	237	254	237	255
8000	-5	-11	2230	100	878	232	257	233	258	234	259	235	260
10,000	-8	-15	2230	100	856	230	262	231	263	232	264	233	265
12,000	-12	-19	2230	100	838	227	267	229	268	230	270	231	271
14,000	-16	-23	2230	100	824	225	272	226	274	227	275	228	276
16,000	-19	-27	2230	100	812	222	278	224	279	225	281	226	282
18,000	-23	-31	2141	96	776	216	279	218	281	219	283	221	284
20,000	-27	-35	2052	92	734	210	279	211	281	213	283	214	285
22,000	-31	-39	1940	87	698	203	278	205	282	207	284	208	286
24,000	-35	-43	1829	82	654	195	277	197	281	200	283	201	286
26,000	-39	-47	1695	76	608	186	274	189	278	191	281	194	284
28,000	-44	-51	1561	70	560	176	269	180	274	183	278	185	282
29,000	-46	-52	1494	67	536	171	265	175	271	178	276	181	280
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-60. Normal Cruise Power, 1800 RPM, ISA – 10 °C

NORMAL CRUISE POWER
1800 RPM
ISA

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	20	15	2230	100	984	240	241	241	242	242	243	243	244
2000	17	11	2230	100	956	238	246	239	247	240	248	240	248
4000	13	7	2230	100	928	235	250	236	251	237	252	238	253
6000	9	3	2230	100	902	233	255	234	256	235	257	236	258
8000	5	-1	2230	100	880	230	260	232	261	233	262	234	263
10,000	2	-5	2230	100	858	228	265	229	266	230	267	231	269
12,000	-2	-9	2230	100	838	226	270	227	272	228	273	229	274
14,000	-6	-13	2230	100	882	223	275	224	277	226	278	227	280
16,000	-9	-17	2163	97	792	218	278	219	279	221	281	222	283
18,000	-13	-21	2029	91	744	210	276	212	279	213	281	215	282
20,000	-17	-25	1940	87	708	204	277	206	279	207	282	209	284
22,000	-21	-29	1851	83	672	197	277	199	280	201	283	203	285
24,000	-25	-33	1739	78	630	189	275	192	278	194	282	196	284
26,000	-29	-37	1628	73	582	180	271	183	275	186	279	188	282
28,000	-34	-41	1494	67	536	170	265	174	271	177	275	180	279
29,000	-36	-42	1427	64	514	164	260	168	267	172	273	175	277
31,000	-40	-46	1316	59	474	151	248	158	260	163	268	166	273
33,000	-45	-50	1182	53	434	131	225	145	248	152	260	157	268
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-61. Normal Cruise Power, 1800 RPM, ISA

NORMAL CRUISE POWER
1800 RPM
ISA + 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	31	25	2230	100	990	238	244	239	245	240	246	241	246
2000	27	21	2230	100	962	236	248	237	249	238	250	239	251
4000	23	17	2230	100	936	234	253	235	254	236	255	237	256
6000	19	13	2230	100	910	231	258	232	259	233	260	234	261
8000	16	9	2230	100	886	229	263	230	264	231	265	232	266
10,000	12	5	2230	100	862	226	268	228	269	229	270	230	272
12,000	8	1	2230	100	840	224	273	225	275	226	276	227	277
14,000	4	-3	2163	97	802	218	275	220	277	221	278	222	280
16,000	0	-7	2052	92	756	212	275	213	277	215	279	216	281
18,000	-4	-11	1962	88	714	205	275	207	277	208	280	210	281
20,000	-7	-15	1873	84	682	199	275	201	278	203	281	204	283
22,000	-11	-19	1784	80	648	191	275	194	278	196	281	198	283
24,000	-15	-23	1673	75	606	183	272	186	276	188	279	191	282
26,000	-20	-27	1539	69	560	174	267	177	272	180	277	183	280
28,000	-24	-31	1405	63	514	163	260	167	267	171	272	174	277
29,000	-26	-32	1360	61	494	149	247	162	263	166	270	170	275
31,000	-31	-36	1227	55	454	133	229	150	253	156	263	161	270
33,000	-36	-40	1115	50	414	– – –	– – –	135	237	145	254	151	264
35,000	-40	-44	1026	46	380	– – –	– – –	– – –	– – –	130	237	140	254

Figure 7-62. Normal Cruise Power, 1800 RPM, ISA + 10 °C

NORMAL CRUISE POWER
1800 RPM
ISA + 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	41	35	2230	100	994	237	246	238	247	239	248	240	249
2000	37	31	2230	100	968	235	251	236	252	237	253	237	254
4000	33	27	2230	100	940	232	255	233	257	234	258	235	259
6000	29	23	2230	100	914	230	261	231	262	232	263	233	264
8000	26	19	2230	100	890	227	266	228	267	230	268	230	269
10,000	22	15	2208	99	862	224	270	225	271	227	273	228	274
12,000	18	11	2096	94	806	217	270	219	271	220	273	221	275
14,000	14	7	2007	90	762	211	270	213	273	214	274	215	276
16,000	10	3	1918	86	722	205	271	207	273	208	276	210	277
18,000	6	-1	1851	83	682	198	271	200	274	202	276	204	279
20,000	2	-5	1784	80	656	193	273	195	276	197	279	199	281
22,000	-1	-9	1717	77	626	187	273	189	277	191	280	193	283
24,000	-6	-13	1606	72	584	178	270	181	274	184	278	186	282
26,000	-10	-17	1472	66	538	168	264	172	270	175	274	178	279
28,000	-14	-21	1338	60	494	155	253	161	263	165	269	169	274
29,000	-17	-22	1271	57	472	147	245	155	257	160	266	164	272
31,000	-21	-26	1160	52	434	– – –	– – –	142	245	150	258	155	266
33,000	-25	-30	1026	46	380	– – –	– – –	– – –	– – –	137	245	145	259
35,000	-29	-34	982	44	368	– – –	– – –	– – –	– – –	– – –	– – –	132	246

Figure 7-63. Normal Cruise Power, 1800 RPM, ISA + 20 °C

NORMAL CRUISE POWER
1800 RPM
ISA + 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	2230	100	1000	235	249	237	250	237	251	238	251
2000	47	41	2230	100	972	233	253	234	254	235	255	236	256
4000	43	37	2230	100	944	231	258	232	259	233	261	234	262
6000	40	33	2230	100	916	228	263	229	264	230	265	231	267
8000	36	29	2141	96	868	222	264	224	266	225	267	226	268
10,000	32	25	2052	92	818	216	265	218	267	219	269	220	270
12,000	28	21	1962	88	766	209	265	211	267	213	269	214	271
14,000	24	17	1873	84	724	203	265	205	268	207	270	208	272
16,000	20	13	1806	81	686	197	266	199	269	201	271	203	273
18,000	16	9	1717	77	652	191	267	194	270	196	273	197	275
20,000	12	5	1673	75	626	186	269	189	272	191	275	193	278
22,000	8	1	1628	73	602	181	270	184	274	186	277	188	281
24,000	4	-3	1516	68	560	172	266	175	271	178	275	181	279
26,000	0	-7	1405	63	516	161	259	166	266	170	272	173	276
28,000	-4	-11	1293	58	474	148	247	156	259	160	266	164	272
29,000	-7	-12	1227	55	454	140	237	149	252	155	263	159	270
31,000	-12	-16	1115	50	414	– – –	– – –	134	236	144	253	150	263
33,000	-16	-20	1004	45	384	– – –	– – –	– – –	– – –	128	235	139	253
35,000	-20	-24	914	41	352	– – –	– – –	– – –	– – –	– – –	– – –	123	234

Figure 7-64. Normal Cruise Power, 1800 RPM, ISA + 30 °C

NORMAL CRUISE POWER
1800 RPM
ISA + 37 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	2230	100	1002	234	250	236	251	236	252	237	253
2000	54	48	2208	99	968	231	254	232	255	233	256	236	257
4000	50	44	2163	97	930	227	257	228	258	229	260	231	261
6000	46	40	2096	94	886	222	259	224	261	225	262	226	263
8000	43	36	2029	91	838	217	260	218	262	220	264	221	265
10,000	39	32	1962	88	792	211	262	213	264	214	266	215	267
12,000	35	28	1851	83	738	204	261	206	264	208	266	209	268
14,000	31	24	1784	80	700	198	262	200	265	202	267	203	269
16,000	27	20	1717	77	664	192	262	194	265	196	268	198	270
18,000	23	16	1650	74	630	186	263	189	266	191	269	193	272
20,000	19	12	1606	72	606	181	265	184	269	186	272	188	275
22,000	15	8	1561	70	584	176	266	179	271	182	274	184	278
24,000	11	4	1450	65	544	167	262	171	268	174	273	177	277
26,000	7	0	1360	61	502	156	254	162	263	166	269	169	274
28,000	3	-4	1227	55	460	142	240	151	254	156	263	160	270
29,000	1	-5	1182	53	440	130	223	143	247	151	259	156	267
31,000	-5	-9	1048	47	400	– – –	– – –	125	223	139	247	146	260
33,000	-9	-13	981	44	370	– – –	– – –	– – –	– – –	121	225	134	249
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-65. Normal Cruise Power, 1800 RPM, ISA + 37 °C

NORMAL CRUISE SPEEDS

1800 RPM

WEIGHT 12,000 LBS

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 30 KNOTS IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, BUT WILL BE UNCHANGED IF THE ORIGINAL POWER IS RESET.

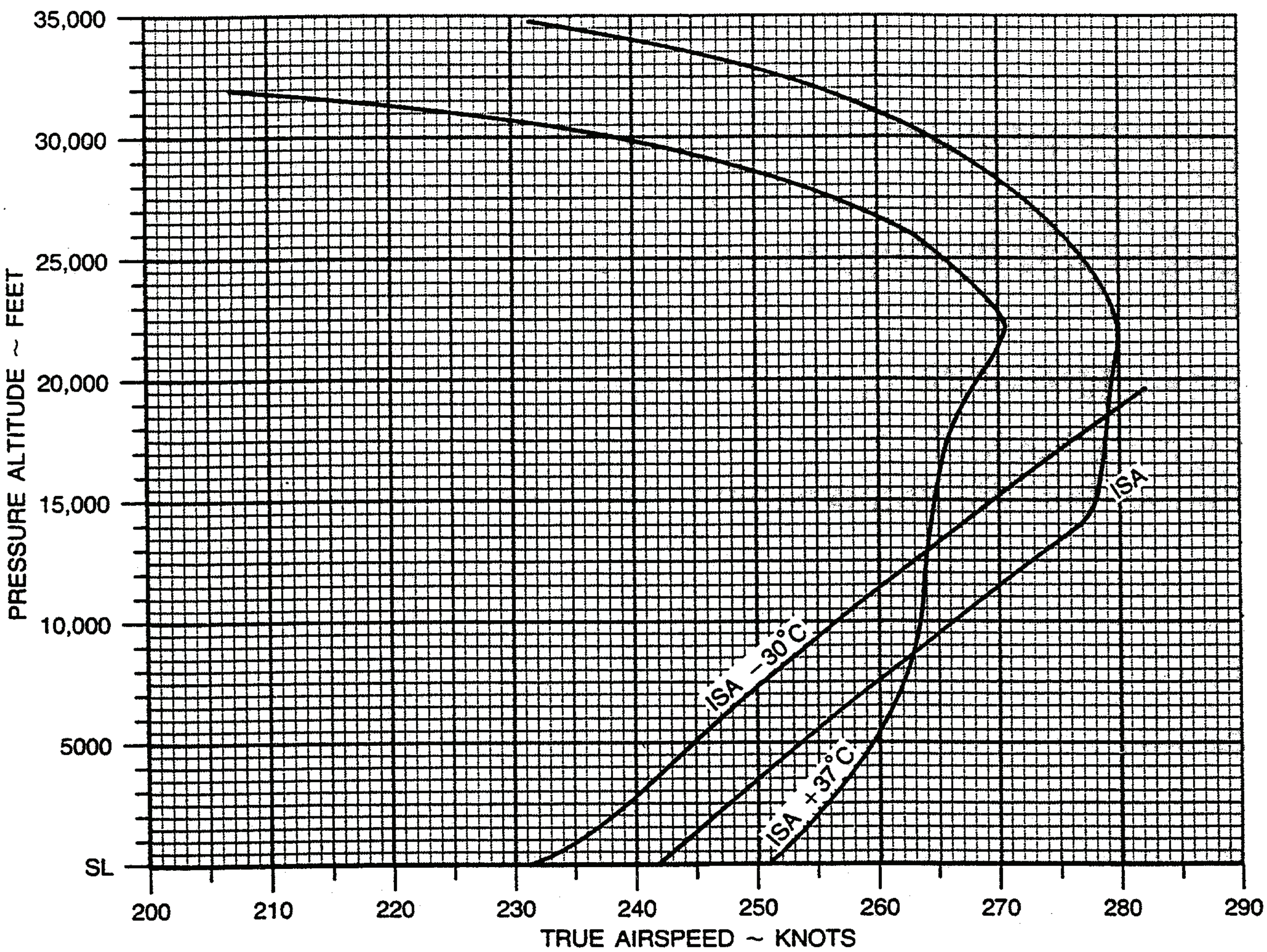


Figure 7-66. Normal Cruise Speeds, 1800 RPM

NORMAL CRUISE POWER

1800 RPM

NOTES: 1. DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE APPROXIMATELY 20%. IF DESIRED, ORIGINAL POWER MAY BE RESET, PROVIDED ITT LIMIT IS NOT EXCEEDED.

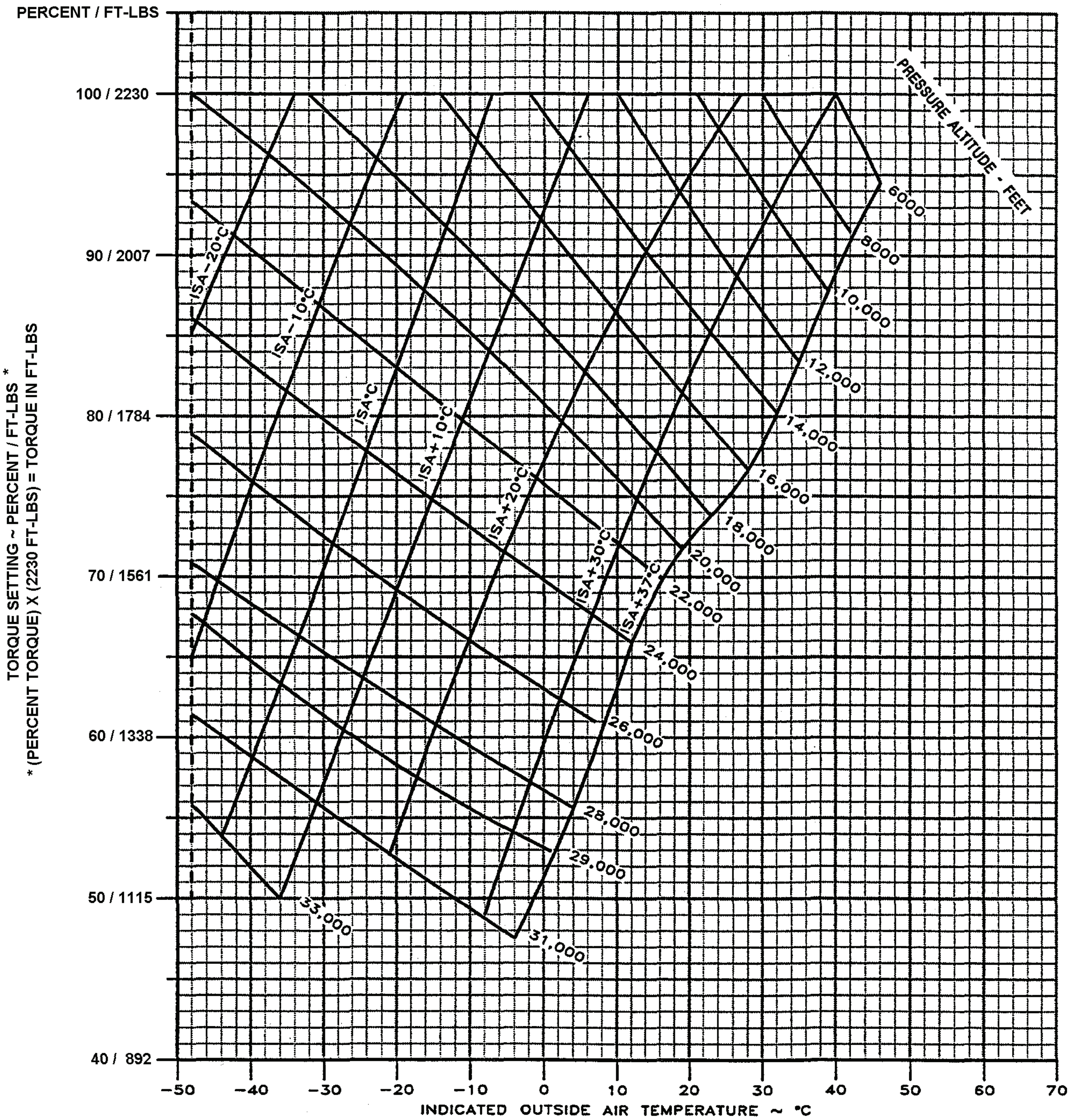


Figure 7-67. Normal Cruise Power, 1800 RPM

FUEL FLOW AT NORMAL CRUISE POWER

1800 RPM

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, FUEL FLOW WILL DECREASE APPROXIMATELY 10% IF ORIGINAL POWER IS NOT OR CANNOT BE RESET. IF ORIGINAL POWER IS RESET, FUEL FLOW WILL INCREASE APPROXIMATELY 30 LBS/HR/ENG

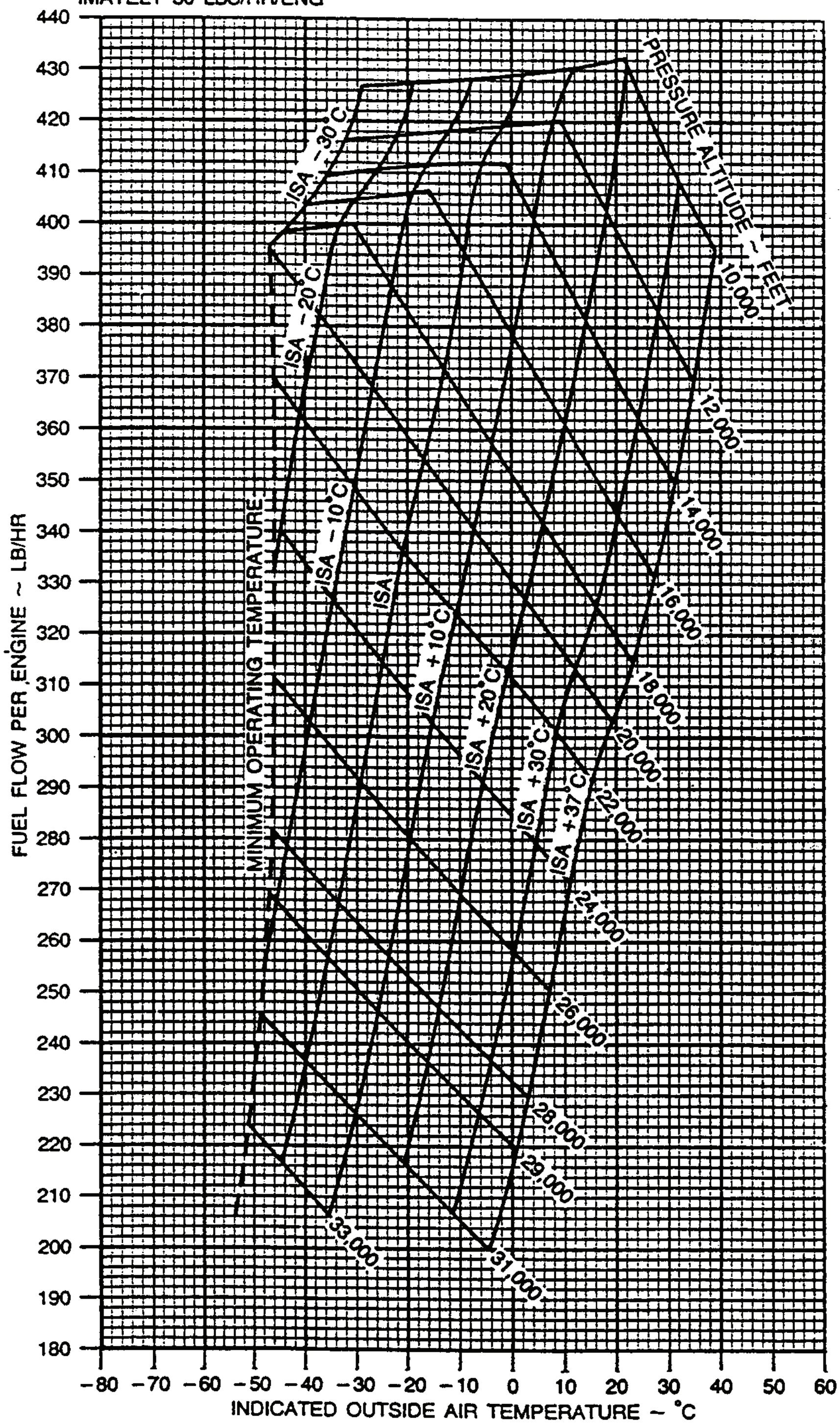


Figure 7-68. Fuel Flow at Normal Cruise Power, 1800 RPM

RANGE PROFILE - NORMAL CRUISE POWER

1800 RPM

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

STANDARD DAY (ISA)
ZERO WIND

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT
FUEL USED .... 2586 LBS

RANGE .... 988 NM

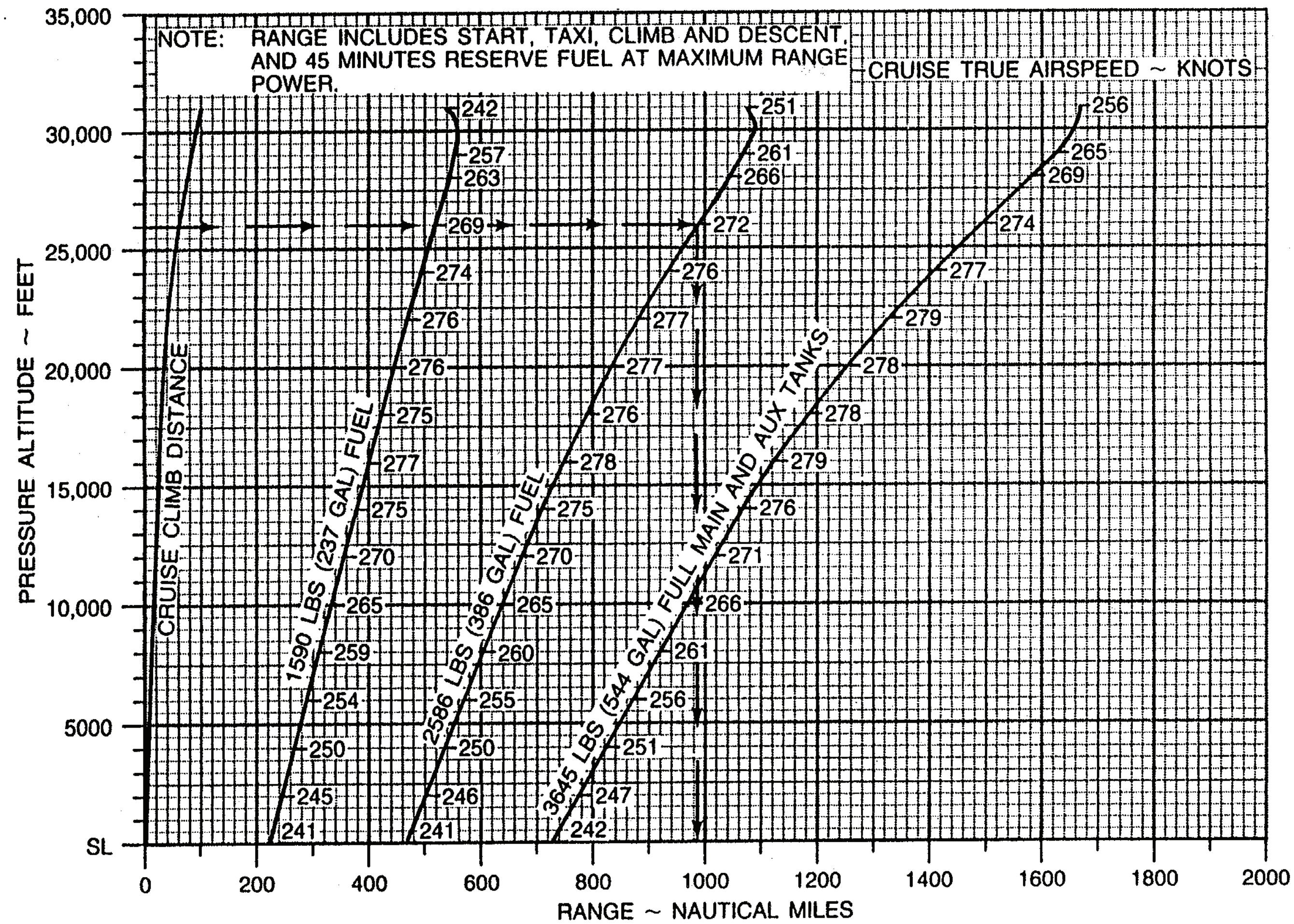


Figure 7-69. Range Profile – Normal Cruise Power, 1800 RPM

MAXIMUM CRUISE POWER
1800 RPM
ISA – 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	2185	98	962	244	232	244	232	244	232	244	232
2000	-14	-19	2230	100	946	243	237	244	238	244	238	244	238
4000	-18	-23	2230	100	920	241	242	241	243	242	243	243	244
6000	-22	-27	2230	100	896	238	246	239	247	240	248	241	249
8000	-25	-31	2230	100	874	236	251	237	252	238	253	239	254
10,000	-29	-35	2230	100	854	233	255	235	257	236	258	236	259
12,000	-33	-39	2230	100	834	231	260	232	262	233	263	234	264
14,000	-36	-43	2230	100	820	229	265	230	267	231	268	232	269
16,000	-40	-47	2230	100	808	226	271	228	272	229	273	230	275
18,000	-44	-51	2230	100	798	224	276	226	278	226	279	228	280
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-70. Maximum Cruise Power, 1800 RPM, ISA – 30 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA – 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	2230	100	972	243	236	244	236	244	236	244	236
2000	-4	-9	2230	100	948	241	240	242	241	243	242	244	243
4000	-8	-13	2230	100	922	239	245	240	246	241	246	241	247
6000	-11	-17	2230	100	898	236	249	237	250	238	251	239	252
8000	-15	-21	2230	100	876	234	254	235	255	236	256	237	257
10,000	-19	-25	2230	100	856	232	259	233	260	234	261	235	262
12,000	-23	-29	2230	100	834	229	264	230	265	231	266	232	267
14,000	-26	-33	2230	100	822	227	269	228	270	230	272	230	273
16,000	-30	-37	2230	100	810	224	274	226	276	227	277	228	278
18,000	-34	-41	2230	100	800	222	280	223	281	225	283	226	284
20,000	-37	-45	2230	100	792	220	285	221	287	222	289	223	290
22,000	-41	-49	2141	96	726	213	286	214	288	216	290	217	292
24,000	-45	-53	2007	90	704	204	284	206	286	208	289	210	291
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-71. Maximum Cruise Power, 1800 RPM, ISA – 20 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA – 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	10	5	2230	100	978	242	238	243	239	243	240	244	241
2000	6	1	2230	100	950	239	243	240	244	241	245	242	246
4000	3	-3	2230	100	926	237	247	238	248	239	249	240	250
6000	-1	-7	2230	100	900	234	252	236	253	237	254	237	255
8000	-5	-11	2230	100	878	232	257	233	258	234	259	235	260
10,000	-9	-15	2230	100	856	230	262	231	263	232	264	233	265
12,000	-12	-19	2230	100	838	227	267	229	268	230	270	231	271
14,000	-16	-23	2230	100	824	225	272	226	274	227	275	228	276
16,000	-20	-27	2230	100	812	222	278	224	279	225	281	226	282
18,000	-24	-31	2230	100	802	220	283	221	285	223	287	223	288
20,000	-27	-35	2141	96	764	213	284	215	286	217	288	218	289
22,000	-31	-39	2029	91	726	206	284	208	286	210	288	212	290
24,000	-35	-43	1918	86	682	199	282	201	285	203	288	204	290
26,000	-40	-47	1784	80	632	190	279	192	283	195	286	197	288
28,000	-44	-51	1628	73	582	181	274	183	279	186	283	188	286
29,000	-46	-52	1561	70	556	175	271	178	276	181	280	184	284
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-72. Maximum Cruise Power, 1800 RPM, ISA – 10 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	20	15	2230	100	946	240	241	241	242	242	243	243	244
2000	16	11	2230	100	920	238	246	239	247	240	248	240	248
4000	13	7	2230	100	892	235	250	236	251	237	252	238	253
6000	9	3	2230	100	866	233	255	234	256	235	257	236	258
8000	5	-1	2230	100	844	230	260	232	261	233	262	234	263
10,000	1	-5	2230	100	822	228	265	229	266	230	267	231	269
12,000	-2	-9	2230	100	800	226	270	227	272	228	273	229	274
14,000	-6	-13	2230	100	786	223	275	224	277	226	278	227	280
16,000	-10	-17	2230	100	776	221	281	222	283	223	284	224	285
18,000	-13	-21	2119	95	772	213	281	216	283	217	285	218	287
20,000	-17	-25	2029	91	734	207	282	209	284	211	286	212	288
22,000	-21	-29	1940	87	698	201	282	203	284	204	287	206	289
24,000	-25	-33	1829	82	654	192	280	195	283	197	286	199	288
26,000	-29	-37	1695	76	606	184	276	186	280	189	284	191	287
28,000	-34	-41	1561	70	560	174	271	177	276	180	281	183	284
29,000	-36	-42	1494	67	538	169	268	172	273	176	278	178	283
31,000	-40	-46	1383	62	496	157	258	162	267	167	274	170	279
33,000	-45	-50	1249	56	454	140	240	150	257	157	267	161	274
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-73. Maximum Cruise Power, 1800 RPM, ISA

MAXIMUM CRUISE POWER
1800 RPM
ISA + 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	31	25	2230	100	990	238	244	239	245	240	246	241	246
2000	27	21	2230	100	962	236	248	237	249	238	250	239	251
4000	23	17	2230	100	936	234	253	235	254	236	255	237	256
6000	19	13	2230	100	910	231	258	232	259	233	260	234	261
8000	16	9	2230	100	886	229	263	230	264	231	265	232	266
10,000	12	5	2230	100	862	226	268	228	269	229	270	230	272
12,000	8	1	2230	100	840	224	273	225	275	226	276	227	277
14,000	5	-3	2230	100	824	221	278	223	280	224	282	225	283
16,000	1	-7	2141	96	782	215	279	216	281	218	283	219	284
18,000	-3	-11	2029	91	742	208	279	210	282	212	284	213	286
20,000	-7	-15	1962	88	708	202	280	204	283	206	285	207	287
22,000	-11	-19	1851	83	672	195	279	197	282	199	285	201	288
24,000	-15	-23	1717	77	628	187	277	189	281	192	284	194	287
26,000	-19	-27	1606	72	582	177	273	181	277	183	281	186	285
28,000	-24	-31	1494	67	536	167	267	171	273	175	278	177	282
29,000	-26	-32	1427	64	516	161	262	166	270	170	275	173	280
31,000	-30	-36	1293	58	474	148	250	156	262	161	270	164	276
33,000	-35	-40	1182	53	436	– – –	– – –	143	250	150	263	155	271
35,000	-39	-44	1093	49	402	– – –	– – –	– – –	– – –	137	249	145	263

Figure 7-74. Maximum Cruise Power, 1800 RPM, ISA + 10 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA + 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	41	35	2230	100	994	337	246	238	247	239	248	240	249
2000	37	31	2230	100	968	235	251	236	252	237	253	237	254
4000	33	27	2230	100	940	232	255	233	257	234	258	235	259
6000	29	23	2230	100	914	230	261	231	262	232	263	233	264
8000	26	19	2230	100	890	227	266	228	267	230	268	230	269
10,000	22	15	2230	100	868	225	271	226	272	227	273	228	275
12,000	18	11	2141	96	820	219	272	220	274	222	275	223	277
14,000	14	7	2074	93	780	213	274	215	276	216	277	218	279
16,000	10	3	2007	90	744	208	275	210	277	211	279	213	281
18,000	7	-1	1918	86	710	202	276	204	279	206	281	207	283
20,000	3	-5	1851	83	678	196	277	198	280	200	283	202	285
22,000	-1	-9	1784	80	648	190	278	192	281	194	284	996	287
24,000	-5	-13	1673	75	606	181	275	184	279	187	283	189	286
26,000	-9	-17	1539	69	560	172	270	175	275	178	279	181	283
28,000	-14	-21	1405	63	516	161	262	165	269	169	275	172	279
29,000	-16	-22	1338	60	494	154	255	160	265	164	272	168	277
31,000	-21	-26	1227	55	454	137	237	148	255	154	266	1559	273
33,000	-26	-30	1115	50	416	– – –	– – –	132	237	143	256	150	267
35,000	-30	-34	1026	46	382	– – –	– – –	– – –	– – –	127	236	138	256

Figure 7-75. Maximum Cruise Power, 1800 RPM, ISA + 20 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA + 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	2230	100	1000	235	248	236	250	237	251	238	251
2000	47	41	2230	100	972	233	253	234	254	235	255	236	256
4000	43	37	2230	100	944	231	258	232	259	233	261	234	262
6000	40	33	2230	100	918	228	263	229	264	230	266	231	267
8000	36	29	2185	98	878	224	266	225	267	226	269	227	270
10,000	32	25	2096	94	830	218	267	219	269	221	270	222	272
12,000	28	21	1985	89	774	211	267	212	269	214	270	215	272
14,000	24	17	1918	86	740	205	268	207	271	209	273	210	275
16,000	20	13	1873	84	706	200	270	202	273	204	275	205	277
18,000	16	9	1806	81	674	195	272	197	275	199	277	201	279
20,000	13	5	1739	78	650	190	274	182	277	194	280	196	283
22,000	9	1	1695	76	622	184	274	187	278	189	281	191	284
24,000	5	-3	1583	71	580	175	271	179	276	181	280	184	283
26,000	0	-7	1472	66	538	166	266	170	272	173	277	176	281
28,000	-4	-11	1360	61	496	154	257	161	266	164	273	168	278
29,000	-6	-12	1293	58	476	147	248	154	261	159	269	163	276
31,000	-11	-16	1182	53	436	– – –	– – –	141	248	149	262	154	270
33,000	-15	-20	1070	48	404	– – –	– – –	– – –	– – –	135	248	144	262
35,000	-19	-24	981	44	370	– – –	– – –	– – –	– – –	– – –	– – –	130	247

Figure 7-76. Maximum Cruise Power, 1800 RPM, ISA + 30 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA + 37 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	2230	100	1002	234	250	236	251	236	252	237	253
2000	54	48	2230	100	974	232	255	233	256	234	257	235	258
4000	50	44	2208	99	940	228	258	230	260	231	261	232	262
6000	46	40	2141	96	894	223	261	225	262	226	264	227	265
8000	43	36	2052	92	846	218	262	219	264	221	265	222	267
10,000	39	32	1985	89	798	212	263	214	265	215	267	216	268
12,000	35	28	1873	84	746	205	263	207	265	209	267	210	269
14,000	31	24	1829	82	712	200	264	202	267	204	269	205	271
16,000	27	20	1762	79	682	195	266	197	269	199	272	201	274
18,000	23	16	1717	77	650	190	268	192	271	194	274	196	276
20,000	19	12	1673	75	628	185	2670	187	274	190	277	192	280
22,000	15	8	1628	73	602	179	271	182	275	185	279	187	282
24,000	11	4	1516	68	564	171	268	174	273	177	277	180	281
26,000	7	0	1405	63	522	161	262	166	269	169	274	172	279
28,000	3	-4	1293	58	480	148	250	156	262	160	269	164	275
29,000	0	-5	1249	56	460	139	239	149	256	155	266	159	273
31,000	-4	-9	1115	50	422	– – –	– – –	134	239	144	257	150	267
33,000	-8	-13	1048	47	390	– – –	– – –	– – –	– – –	130	241	140	258
35,000	-12	-17	959	43	360	– – –	– – –	– – –	– – –	– – –	– – –	125	242

Figure 7-77. Maximum Cruise Power, 1800 RPM, ISA + 37 °C

MAXIMUM CRUISE SPEEDS

1800 RPM

WEIGHT 12,000 LBS

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 30 KNOTS IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, BUT WILL BE UNCHANGED IF THE ORIGINAL POWER IS RESET.

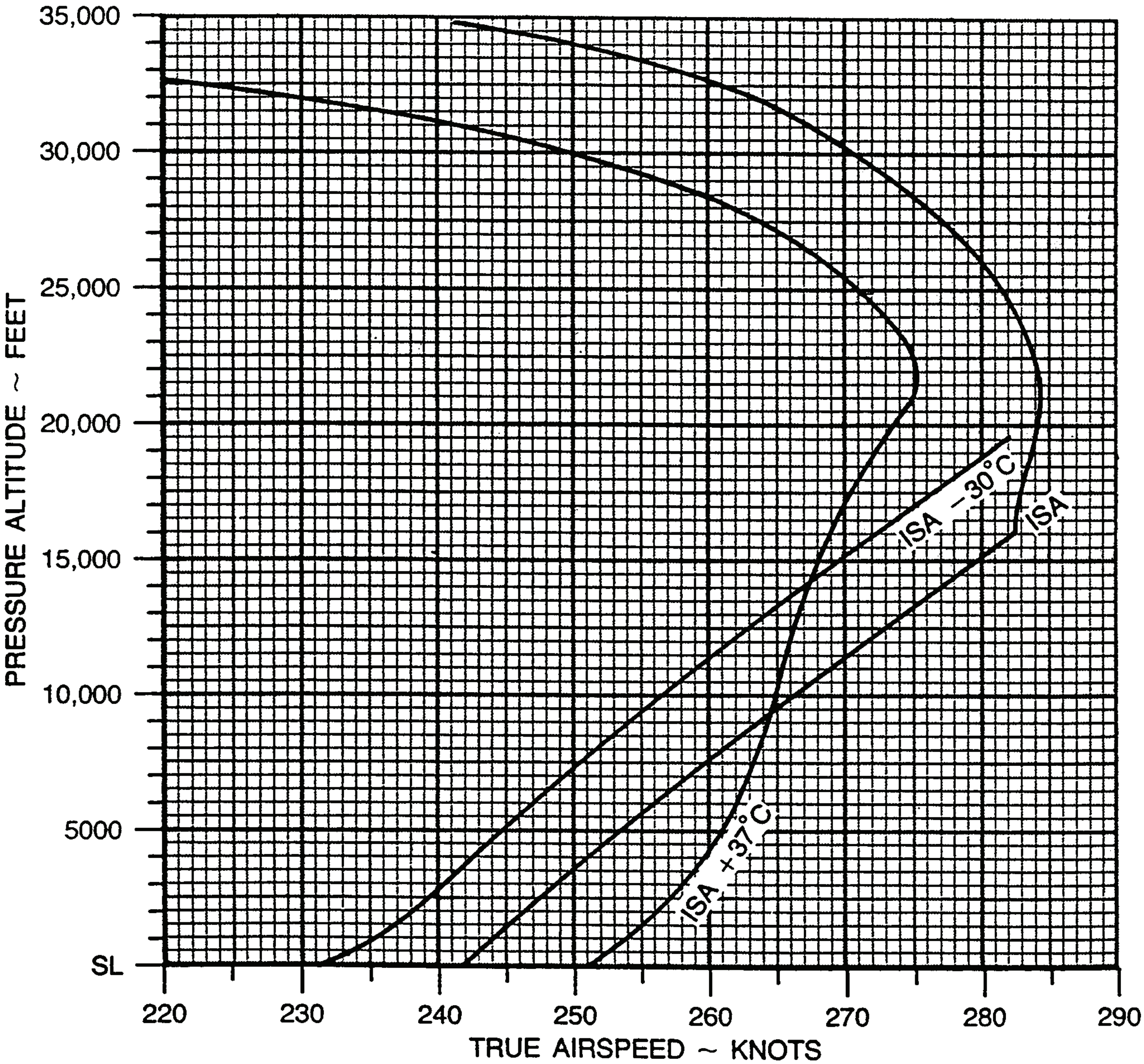


Figure 7-78. Maximum Cruise Speeds, 1800 RPM

MAXIMUM CRUISE POWER

1800 RPM

NOTES: 1. DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE APPROXIMATELY 20%. IF DESIRED, ORIGINAL POWER MAY BE RESET, PROVIDED ITT LIMIT IS NOT EXCEEDED.

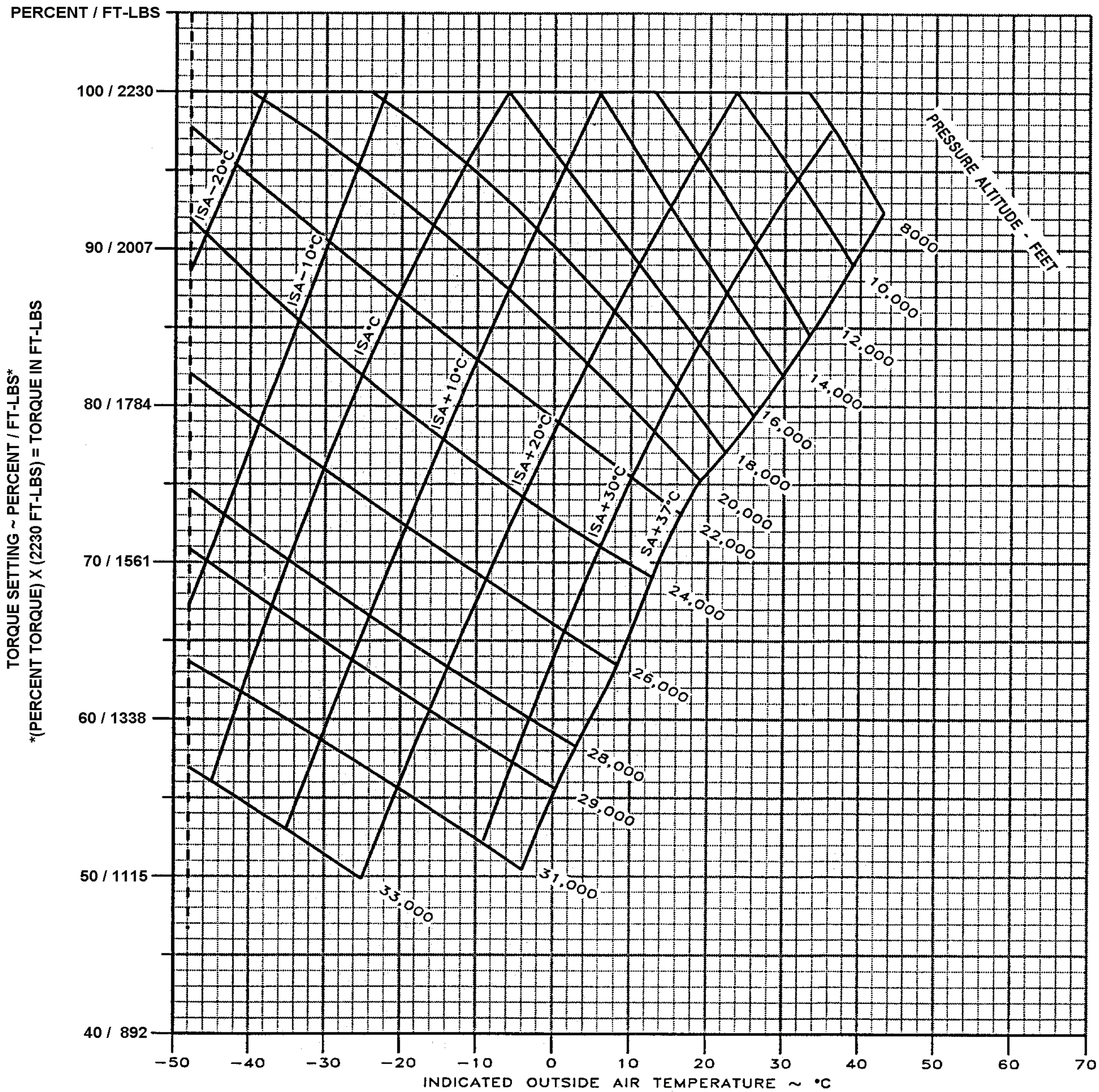


Figure 7-79. Maximum Cruise Power, 1800 RPM

FUEL FLOW AT MAXIMUM CRUISE POWER

1800 RPM

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, FUEL FLOW WILL DECREASE APPROXIMATELY 10% IF ORIGINAL POWER IS NOT OR CANNOT BE RESET. IF ORIGINAL POWER IS RESET, FUEL FLOW WILL INCREASE APPROXIMATELY 30 LBS/HR/ENG.

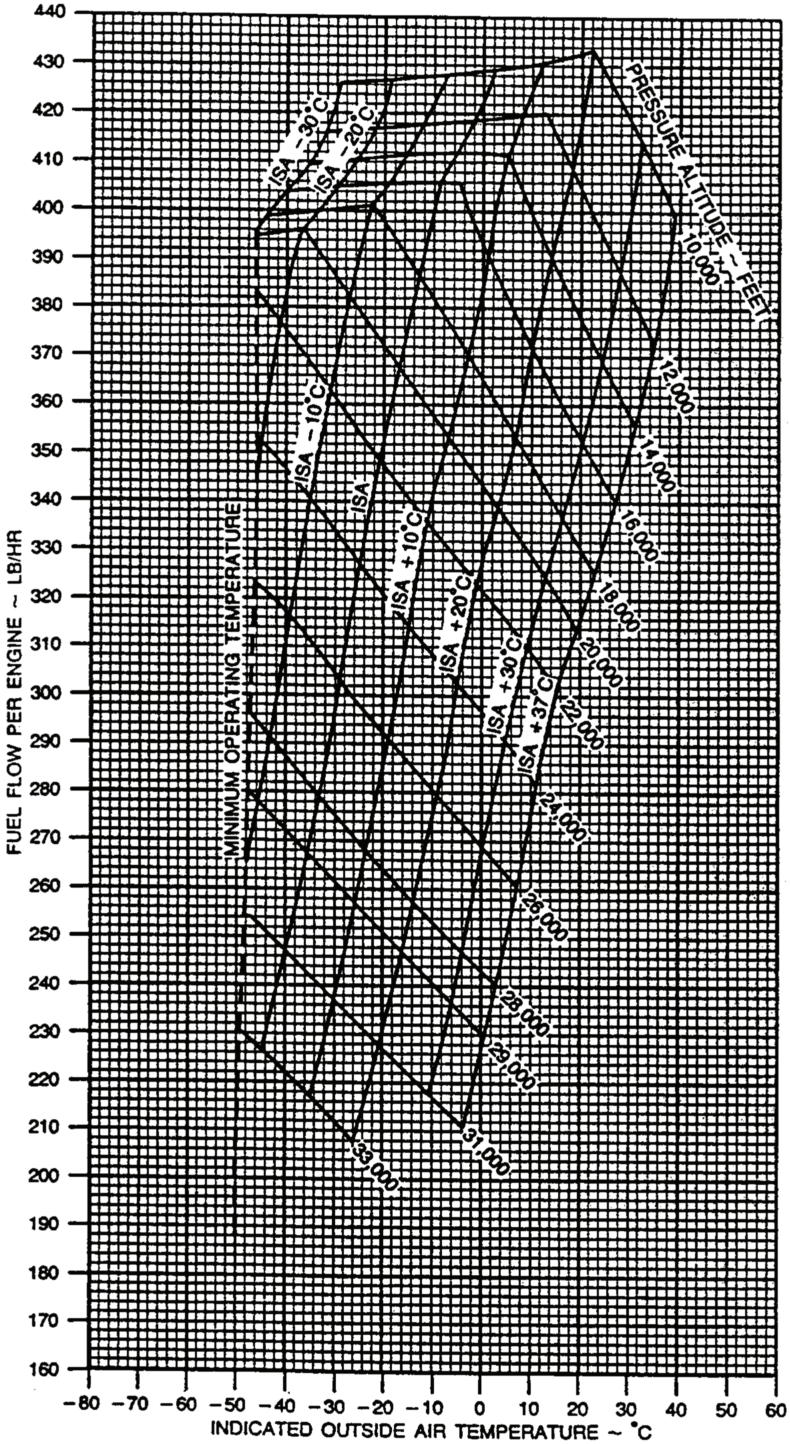


Figure 7-80. Fuel Flow At Maximum Cruise Power, 1800 RPM

RANGE PROFILE - MAXIMUM CRUISE POWER

1800 RPM

STANDARD DAY (ISA)
ZERO WIND

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT
FUEL USED .... 2586 LBS

RANGE .... 968 NM

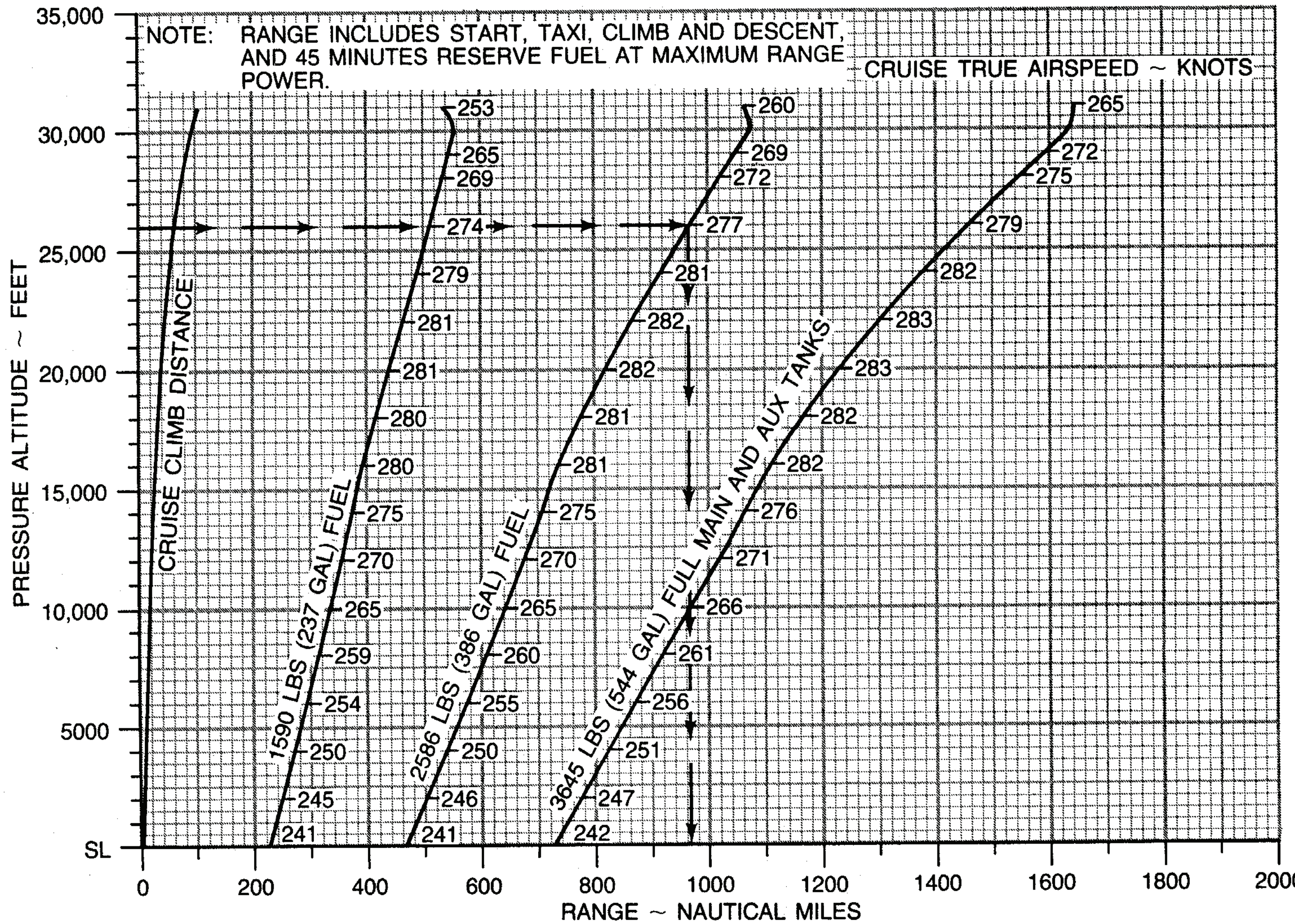


Figure 7-81. Range Profile - Maximum Cruise Power, 1800 RPM

MAXIMUM RANGE POWER
1700 RPM
ISA – 30 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS					12,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	-11	-15	1628	73	788	210	200	1539	69	768	207	197
2,000	-15	-19	1494	67	730	201	197	1427	64	710	199	195
4,000	-20	-23	1405	63	674	194	195	1316	59	654	191	192
6,000	-24	-27	1316	59	628	187	194	1227	55	604	184	191
8,000	-28	-31	1249	56	584	181	193	1160	52	560	177	189
10,000	-32	-35	1204	54	546	175	193	1093	49	520	171	189
12,000	-35	-39	1182	53	516	171	194	1070	48	488	167	189
14,000	-39	-43	1137	51	490	167	194	1026	46	460	162	189
16,000	-43	-47	1115	50	468	163	196	1004	45	436	158	190
18,000	-47	-51	1115	50	446	158	197	981	44	412	153	190
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-82. Maximum Range Power, 1700 RPM, ISA – 30 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA – 30 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS					10,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	-11	-15	1472	66	734	205	195	1405	63	736	203	193
2,000	-15	-19	1360	61	694	197	192	1271	57	672	194	190
4,000	-20	-23	1227	55	632	188	189	1137	51	612	184	186
6,000	-24	-27	1137	51	580	180	187	1048	47	556	176	183
8,000	-28	-31	1070	48	534	173	185	959	43	510	169	180
10,000	-32	-35	1004	45	492	167	184	892	40	466	162	179
12,000	-35	-39	959	43	458	162	184	847	38	430	157	178
14,000	-39	-43	914	41	428	156	183	781	35	398	150	176
16,000	-43	-47	870	39	402	152	183	758	34	368	145	175
18,000	-47	-51	847	38	376	146	182	691	31	338	138	172
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-82. Maximum Range Power, 1700 RPM, ISA – 30 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA – 20 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS					12,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	-1	-5	1717	77	814	214	207	1650	74	796	211	205
2,000	-5	-9	1606	72	758	206	205	1494	67	734	202	201
4,000	-9	-13	1494	67	702	197	202	1405	63	678	194	199
6,000	-13	-17	1405	63	654	191	201	1316	59	632	187	198
8,000	-17	-21	1338	60	612	185	201	1249	56	588	181	197
10,000	-21	-25	1271	57	568	178	200	1182	53	544	175	196
12,000	-25	-29	1249	56	540	174	201	1160	52	514	170	197
14,000	-29	-33	1227	55	514	170	202	1115	50	486	166	198
16,000	-33	-37	1204	54	490	165	203	1093	49	460	161	198
18,000	-37	-41	1182	53	472	162	205	1070	48	440	157	199
20,000	-41	-45	1182	53	465	158	207	1048	47	420	152	200
22,000	-45	-49	1182	53	446	156	211	1048	47	408	150	203
24,000	-49	-53	1204	54	444	155	217	1070	48	404	149	208
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-83. Maximum Range Power, 1700 RPM, ISA – 20 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA – 20 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS					10,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	-1	-5	1561	70	776	208	202	1494	67	760	206	200
2,000	-5	-9	1427	64	716	199	199	1360	61	698	197	196
4,000	-9	-13	1316	59	660	191	196	1249	56	642	189	194
6,000	-13	-17	1249	56	612	185	195	1160	52	592	182	192
8,000	-17	-21	1160	52	568	178	194	1093	49	546	175	191
10,000	-21	-25	1093	49	522	171	192	1004	45	500	168	188
12,000	-25	-29	1048	47	490	167	193	959	43	466	163	188
14,000	-29	-33	1026	46	460	162	193	914	41	434	157	187
16,000	-33	-37	981	44	432	156	192	847	38	402	151	186
18,000	-37	-41	937	42	408	152	193	825	37	374	145	185
20,000	-41	-45	914	41	384	147	192	781	35	348	139	183
22,000	-45	-49	914	41	370	143	195	758	34	332	136	185
24,000	-49	-53	937	42	366	142	200	803	36	328	136	191
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-83. Maximum Range Power, 1700 RPM, ISA – 20 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA – 10 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS					12,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	9	5	1784	80	830	216	213	1695	76	810	213	210
2,000	5	1	1739	76	782	209	212	1606	72	760	206	209
4,000	1	-3	1583	71	728	201	210	1494	67	704	198	207
6,000	-3	-7	1494	67	678	194	209	1405	63	656	191	205
8,000	-7	-11	1427	64	634	188	208	1338	60	610	184	204
10,000	-11	-15	1360	61	590	181	207	1271	57	566	178	203
12,000	-15	-19	1338	60	562	177	209	1227	55	536	173	204
14,000	-19	-23	1293	58	534	173	210	1182	53	506	168	205
16,000	-23	-27	1271	57	514	169	212	1160	52	482	164	206
18,000	-27	-31	1271	57	494	165	213	1137	51	460	159	207
20,000	-31	-35	1249	56	480	162	217	1115	50	442	156	209
22,000	-34	-39	1271	57	470	160	221	1115	50	430	153	212
24,000	-38	-43	1271	57	464	158	226	1137	51	426	152	218
26,000	-42	-47	1293	58	460	156	232	1160	52	422	151	224
28,000	-46	-51	1293	58	452	153	234	1182	53	420	150	230
29,000	-48	-52	1316	59	458	153	239	1182	53	420	149	232
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-84. Maximum Range Power, 1700 RPM, ISA – 10 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA – 10 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS					10,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	9	5	1628	73	790	210	207	1539	69	774	207	205
2,000	5	1	1516	68	740	203	206	1427	64	720	200	203
4,000	1	-3	1383	62	682	194	203	1316	59	660	190	199
6,000	-3	-7	1316	59	632	187	201	1227	55	612	184	198
8,000	-7	-11	1227	55	586	181	200	1160	52	566	177	197
10,000	-11	-15	1160	52	542	174	199	1093	49	520	171	196
12,000	-15	-19	1137	51	510	169	200	1048	47	488	166	196
14,000	-19	-23	1093	49	480	164	200	981	44	456	160	195
16,000	-23	-27	1048	47	454	159	200	937	42	428	155	195
18,000	-27	-31	1004	45	428	154	200	892	40	400	149	194
20,000	-31	-35	981	44	408	150	201	870	39	378	145	194
22,000	-34	-39	981	44	394	147	204	847	38	360	141	196
24,000	-38	-43	1004	45	388	146	209	870	39	352	140	200
26,000	-42	-47	1026	46	384	145	215	892	40	346	138	206
28,000	-46	-51	1048	47	382	144	221	914	41	344	137	211
29,000	-48	-52	1070	48	384	144	224	914	41	344	137	214
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-84. Maximum Range Power, 1700 RPM, ISA – 10 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS					12,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	19	15	1806	81	840	217	218	1739	78	822	214	215
2,000	15	11	1717	77	790	210	217	1628	73	770	207	214
4,000	11	7	1650	74	748	204	217	1561	70	724	201	214
6,000	7	3	1561	70	696	197	216	1450	65	672	193	211
8,000	3	-1	1494	67	656	191	216	1405	63	632	188	212
10,000	-1	-5	1450	65	614	186	216	1338	60	588	182	212
12,000	-5	-9	1405	63	582	181	216	1293	58	554	177	212
14,000	-9	-13	1383	62	554	177	219	1271	57	526	172	213
16,000	-12	-17	1360	61	532	173	221	1227	55	500	167	214
18,000	-16	-21	1338	60	514	169	223	1204	54	482	163	216
20,000	-20	-25	1316	59	500	165	226	1182	53	464	160	218
22,000	-24	-29	1316	59	488	162	229	1182	53	452	157	221
24,000	-28	-33	1338	60	482	161	235	1204	54	444	155	227
26,000	-31	-37	1316	59	464	155	235	1227	55	438	154	232
28,000	-35	-41	1316	59	462	153	240	1204	54	428	150	234
29,000	-37	-42	1338	60	466	152	243	1204	54	428	148	236
31,000	-41	-46	– – –	– – –	– – –	– – –	– – –	1227	55	428	146	242
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-85. Maximum Range Power, 1700 RPM, ISA (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT →			11,000 POUNDS					10,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	19	15	1650	74	804	212	213	1606	72	788	210	211
2,000	15	11	1561	70	750	204	211	1472	66	732	201	208
4,000	11	7	1472	66	704	198	210	1405	63	684	195	207
6,000	7	3	1360	61	650	189	208	1093	58	630	186	204
8,000	3	-1	1316	59	608	184	208	1227	55	586	180	204
10,000	-1	-5	1249	56	564	178	207	1137	51	542	174	203
12,000	-5	-9	1204	54	530	173	208	1115	50	506	169	203
14,000	-9	-13	1160	52	498	167	207	1048	47	472	163	202
16,000	-12	-17	1115	50	470	162	207	1004	45	444	157	202
18,000	-16	-21	1070	48	448	158	209	959	43	420	152	202
20,000	-20	-25	1048	47	428	153	210	937	42	396	147	202
22,000	-24	-29	1048	47	414	150	212	914	41	380	144	204
24,000	-28	-33	1070	48	408	149	218	914	41	370	142	208
26,000	-31	-37	1093	49	402	148	224	937	42	364	141	214
28,000	-35	-41	1115	50	400	147	230	959	43	362	141	221
29,000	-37	-42	1115	50	396	145	232	981	44	362	140	224
31,000	-41	-46	1093	49	390	142	235	1004	45	360	139	230
33,000	-45	-50	1115	50	392	140	240	1004	45	356	136	233
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	1004	45	356	134	238

Figure 7-85. Maximum Range Power, 1700 RPM, ISA (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 10 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➜			13,000 POUNDS					12,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	29	25	1717	77	824	211	215	1673	75	812	210	215
2,000	25	21	1673	75	786	207	218	1628	73	774	206	217
4,000	21	17	1650	74	750	203	220	1583	71	736	202	219
6,000	18	13	1606	72	710	198	221	1539	69	694	196	219
8,000	14	9	1561	70	670	193	222	1472	66	648	190	219
10,000	10	5	1494	67	630	188	223	1405	63	606	184	219
12,000	6	1	1472	66	598	183	225	1383	62	576	181	221
14,000	2	-3	1427	64	570	179	226	1338	60	546	176	222
16,000	-2	-7	1405	63	546	174	228	1293	58	520	171	223
18,000	-6	-11	1383	62	542	170	230	1271	57	496	167	225
20,000	-10	-15	1360	61	508	166	232	1249	56	478	162	226
22,000	-14	-19	1360	61	498	163	235	1249	56	468	159	229
24,000	-17	-23	1316	59	478	157	235	1249	56	458	157	233
26,000	-21	-27	1338	60	476	156	240	1227	55	440	152	234
28,000	-25	-31	1338	60	472	152	243	1204	54	434	148	237
29,000	-27	-32	1360	61	474	151	246	1227	55	434	147	240
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-86. Maximum Range Power, 1700 RPM, ISA + 10 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 10 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS					10,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	29	25	1628	73	800	209	214	1583	71	788	208	212
2,000	25	21	1583	71	760	205	215	1516	68	744	202	213
4,000	21	17	1516	68	714	199	215	1427	64	694	196	212
6,000	18	13	1450	65	670	193	215	1360	61	650	190	212
8,000	14	9	1383	62	626	187	215	1293	58	604	183	211
10,000	10	5	1293	58	582	180	214	1204	54	558	176	209
12,000	6	1	1271	57	552	177	216	1182	53	526	173	211
14,000	2	-3	1227	55	520	171	216	1115	50	494	167	211
16,000	-2	-7	1182	53	490	166	217	1070	48	462	161	210
18,000	-6	-11	1137	51	466	161	217	1026	46	434	155	210
20,000	-10	-15	1115	50	444	156	218	981	44	410	150	209
22,000	-14	-19	1115	50	434	153	221	981	44	398	147	212
24,000	-17	-23	1115	50	424	152	226	981	44	390	146	218
26,000	-21	-27	1137	51	416	150	231	1004	45	382	144	223
28,000	-25	-31	1115	50	404	146	234	1026	46	376	143	229
29,000	-27	-32	1115	50	398	144	234	1026	46	374	142	231
31,000	-31	-36	1115	50	398	141	239	1004	45	364	138	233
33,000	-35	-40	1137	51	404	140	246	1004	45	362	135	237
35,000	-39	-44	– – –	– – –	– – –	– – –	– – –	1026	46	368	134	244

Figure 7-86. Maximum Range Power, 1700 RPM, ISA + 10 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 20 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT →			13,000 POUNDS					12,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	39	35	1628	73	810	205	213	1583	71	798	204	212
2,000	35	31	1606	72	722	201	215	1539	69	758	200	214
4,000	31	27	1561	70	734	197	217	1539	69	726	197	217
6,000	28	23	1539	69	698	193	219	1494	67	688	193	219
8,000	24	19	1494	67	660	188	220	1450	65	650	188	221
10,000	20	15	1450	65	622	183	222	1405	63	610	183	222
12,000	16	11	1405	63	588	179	223	1360	61	578	179	223
14,000	12	7	1383	62	562	174	224	1338	60	550	175	225
16,000	8	3	1360	61	538	170	226	1316	59	526	171	227
18,000	4	-1	1338	60	516	166	228	1293	58	504	167	229
20,000	0	-5	1338	60	502	163	231	1293	58	488	163	232
22,000	-3	-9	1316	59	490	159	234	1271	57	472	159	234
24,000	-7	-13	1338	60	484	157	239	1227	55	452	154	234
26,000	-11	-17	1360	61	484	156	245	1227	55	444	151	238
28,000	-15	-21	1360	61	480	152	247	1249	56	446	149	244
29,000	-17	-22	– – –	– – –	– – –	– – –	– – –	1249	56	444	147	245
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-87. Maximum Range Power, 1700 RPM, ISA + 20 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 20 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS					10,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	39	35	1539	69	786	204	212	1494	67	776	203	211
2,000	35	31	1516	68	748	200	214	1450	65	736	199	213
4,000	31	27	1494	67	712	196	217	1427	64	700	196	216
6,000	28	23	1450	65	676	193	219	1383	62	658	190	216
8,000	24	19	1405	63	636	188	220	1316	59	614	184	216
10,000	20	15	1338	60	594	182	220	1249	56	572	178	216
12,000	16	11	1316	59	562	178	222	1227	55	538	174	217
14,000	12	7	1271	57	534	173	223	1182	53	510	170	218
16,000	8	3	1249	56	506	169	224	1137	51	482	165	219
18,000	4	-1	1204	54	482	164	226	1093	49	454	159	219
20,000	0	-5	1182	53	460	159	226	1048	47	428	154	219
22,000	-3	-9	1160	52	442	155	228	1026	46	410	150	220
24,000	-7	-13	1160	52	432	153	232	1026	46	398	147	224
26,000	-11	-17	1137	51	416	148	234	1048	47	390	146	230
28,000	-15	-21	1115	50	406	144	235	1026	46	382	142	233
29,000	-17	-22	1137	51	408	144	239	1026	46	376	140	233
31,000	-21	-26	1137	51	408	142	245	1026	46	372	138	237
33,000	-25	-30	– – –	– – –	– – –	– – –	– – –	1048	47	372	136	243
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-87. Maximum Range Power, 1700 RPM, ISA + 20 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 30 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS					12,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	49	45	1673	75	820	205	217	1561	70	798	202	214
2,000	45	41	1561	70	768	198	215	1494	67	750	196	213
4,000	41	37	1516	68	726	193	216	1450	65	710	192	215
6,000	37	33	1472	66	690	189	218	1427	64	674	188	217
8,000	34	29	1427	64	650	184	219	1383	62	636	183	218
10,000	30	25	1383	62	612	179	19	1338	60	596	178	219
12,000	26	21	1360	61	582	174	221	1316	59	566	174	220
14,000	22	17	1338	60	556	170	223	1271	57	538	169	221
16,000	18	13	1338	60	536	167	226	1249	56	514	165	224
18,000	14	9	1338	60	518	163	229	1249	56	496	162	227
20,000	10	5	1316	59	504	160	232	1249	56	480	159	230
22,000	6	1	1338	60	498	159	238	1227	55	464	155	232
24,000	3	-3	1383	62	498	158	245	1227	55	452	151	235
26,000	-1	-7	1360	61	486	153	246	1271	57	456	152	244
28,000	-5	-11	– – –	– – –	– – –	– – –	– – –	1249	56	448	148	246
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-88. Maximum Range Power, 1700 RPM, ISA + 30 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 30 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS					10,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	49	45	1494	67	780	200	211	1427	64	766	198	209
2,000	45	41	1450	65	736	195	212	1383	62	724	194	211
4,000	41	37	1405	63	700	191	214	1360	61	688	190	213
6,000	37	33	1383	62	664	187	216	1338	60	652	187	216
8,000	34	29	1338	60	626	183	218	1293	58	614	183	218
10,000	30	25	1293	58	588	178	219	1249	56	574	178	218
12,000	26	21	1271	57	556	174	221	1227	55	544	174	220
14,000	22	17	1249	56	528	170	223	1182	53	516	169	222
16,000	18	13	1227	55	504	166	225	1160	52	490	166	224
18,000	14	9	1204	54	484	163	228	1137	51	466	161	226
20,000	10	5	1204	54	468	159	231	1093	49	444	156	226
22,000	6	1	1182	53	450	156	233	1070	48	424	152	228
24,000	3	-3	1137	51	428	150	232	1070	48	408	149	231
26,000	-1	-7	1115	50	410	144	232	1048	47	392	144	232
28,000	-5	-11	1160	52	418	146	244	1004	45	374	139	231
29,000	-7	-12	1160	52	414	144	244	1026	46	376	139	236
31,000	-11	-16	1160	52	410	140	247	1048	47	376	138	243
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-88. Maximum Range Power, 1700 RPM, ISA + 30 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 37 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT →			13,000 POUNDS					12,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	56	52	1717	77	840	207	222	1628	73	814	204	218
2,000	52	48	1650	74	790	201	221	1516	68	760	197	216
4,000	48	44	1561	70	740	194	220	1450	65	714	191	216
6,000	44	40	1472	66	694	188	220	1405	63	670	185	216
8,000	41	36	1450	65	656	183	221	1360	61	632	180	217
10,000	37	32	1405	63	620	179	222	1316	59	594	176	218
12,000	33	28	1405	63	592	175	225	1293	58	564	172	220
14,000	29	24	1383	62	568	171	227	1271	57	538	167	222
16,000	25	20	1383	62	548	168	230	1249	56	516	164	224
18,000	21	16	1383	62	534	166	235	1227	55	496	160	227
20,000	17	12	1383	62	522	163	239	1227	55	482	157	230
22,000	14	8	1383	62	512	160	243	1249	55	470	154	234
24,000	10	4	1383	62	498	156	245	1271	57	468	154	242
26,000	6	0	1405	63	496	154	250	1271	57	458	150	245
28,000	2	-4	– – –	– – –	– – –	– – –	– – –	1293	58	456	148	250
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-89. Maximum Range Power, 1700 RPM, ISA + 37 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 37 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS					10,000 POUNDS				
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE		FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	FT-LB	%	LB/HR	KTS	KTS	FT-LB	%	LB/HR	KTS	KTS
SL	56	52	1516	68	788	200	214	1427	64	766	197	210
2,000	52	48	1427	64	738	194	213	1360	61	720	191	210
4,000	48	44	1383	62	696	189	214	1338	60	682	187	212
6,000	44	40	1338	60	654	184	215	1293	58	644	183	214
8,000	41	36	1293	58	618	179	216	1249	56	606	179	216
10,000	37	32	1249	56	580	175	217	1249	56	568	175	217
12,000	33	28	1227	55	548	171	219	1182	53	536	171	219
14,000	29	24	1204	54	520	166	220	1160	52	510	167	221
16,000	25	20	1182	53	496	162	222	1137	51	486	163	223
18,000	21	16	1160	52	476	159	225	1115	50	464	159	226
20,000	17	12	1160	52	462	156	229	1115	50	448	156	229
22,000	14	8	1160	52	446	152	231	1093	49	430	152	231
24,000	10	4	1115	50	426	147	232	1070	48	408	147	232
26,000	6	0	1160	52	424	147	239	1026	46	386	141	231
28,000	2	-4	1137	51	420	15	244	1048	47	380	139	239
29,000	0	-5	1160	52	418	143	246	1048	47	382	137	245
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-89. Maximum Range Power, 1700 RPM, ISA + 37 °C (Sheet 2 of 2)

RANGE PROFILE - MAXIMUM RANGE POWER

1700 RPM

STANDARD DAY (ISA)
ZERO WIND

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT
FUEL USED .... 2586 LBS

RANGE .... 1065 NM

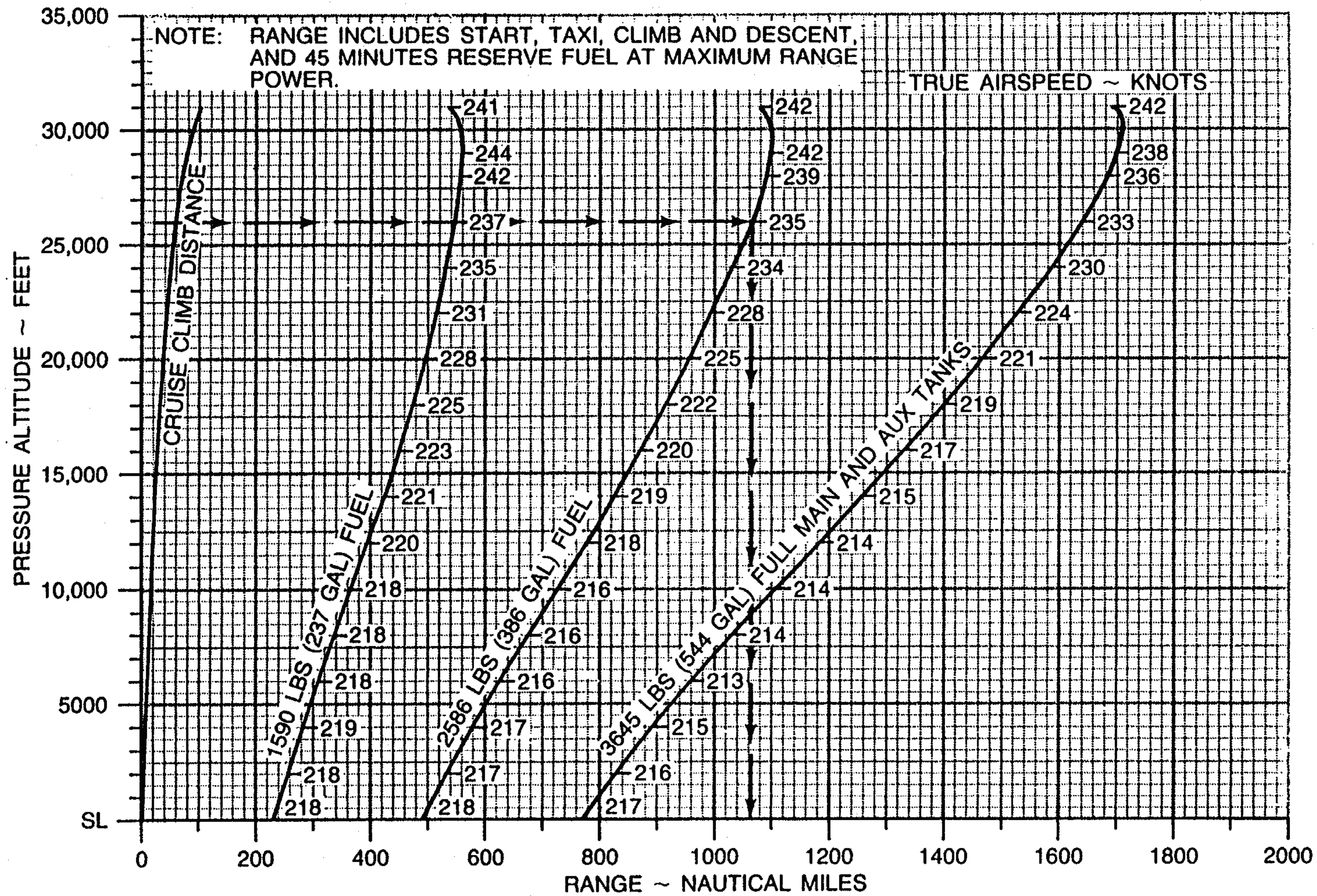


Figure 7-90. Range Profile – Maximum Range Power, 1700 RPM

RANGE PROFILE - FULL MAIN AND AUX TANKS

STANDARD DAY
ZERO WIND

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT

RANGE @ MAX CRUISE - 1800 RPM .... 1460 NM
RANGE @ MAX RANGE - 1700 RPM .... 1640 NM

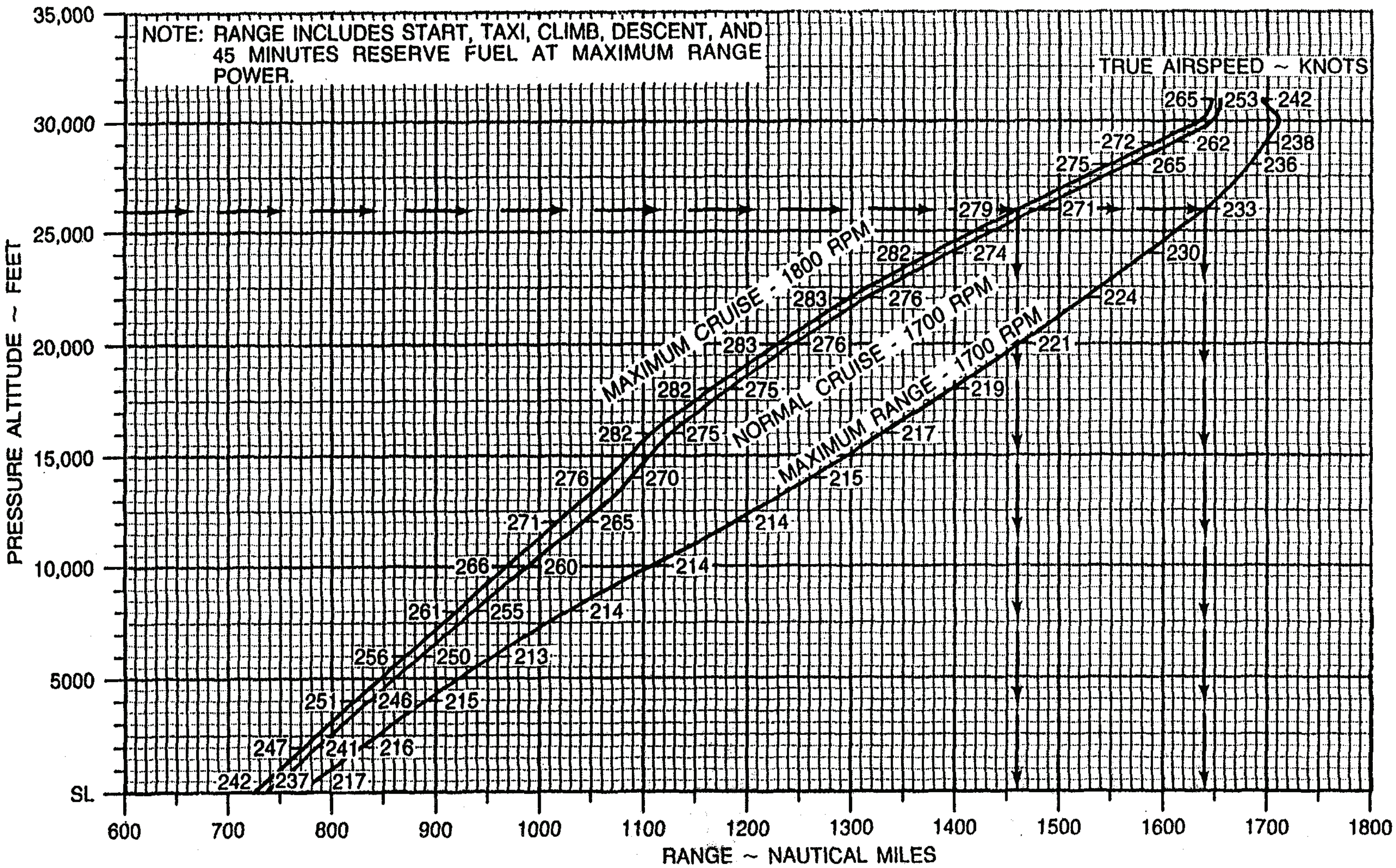


Figure 7-91. Range Profile – Full Main and Auxiliary Tanks

ENDURANCE PROFILE - FULL MAIN AND AUX TANKS

STANDARD DAY

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT

RANGE @ MAX CRUISE - 1800 RPM .... 5.37 HRS
RANGE @ MAX RANGE - 1700 RPM .... 7.05 HRS

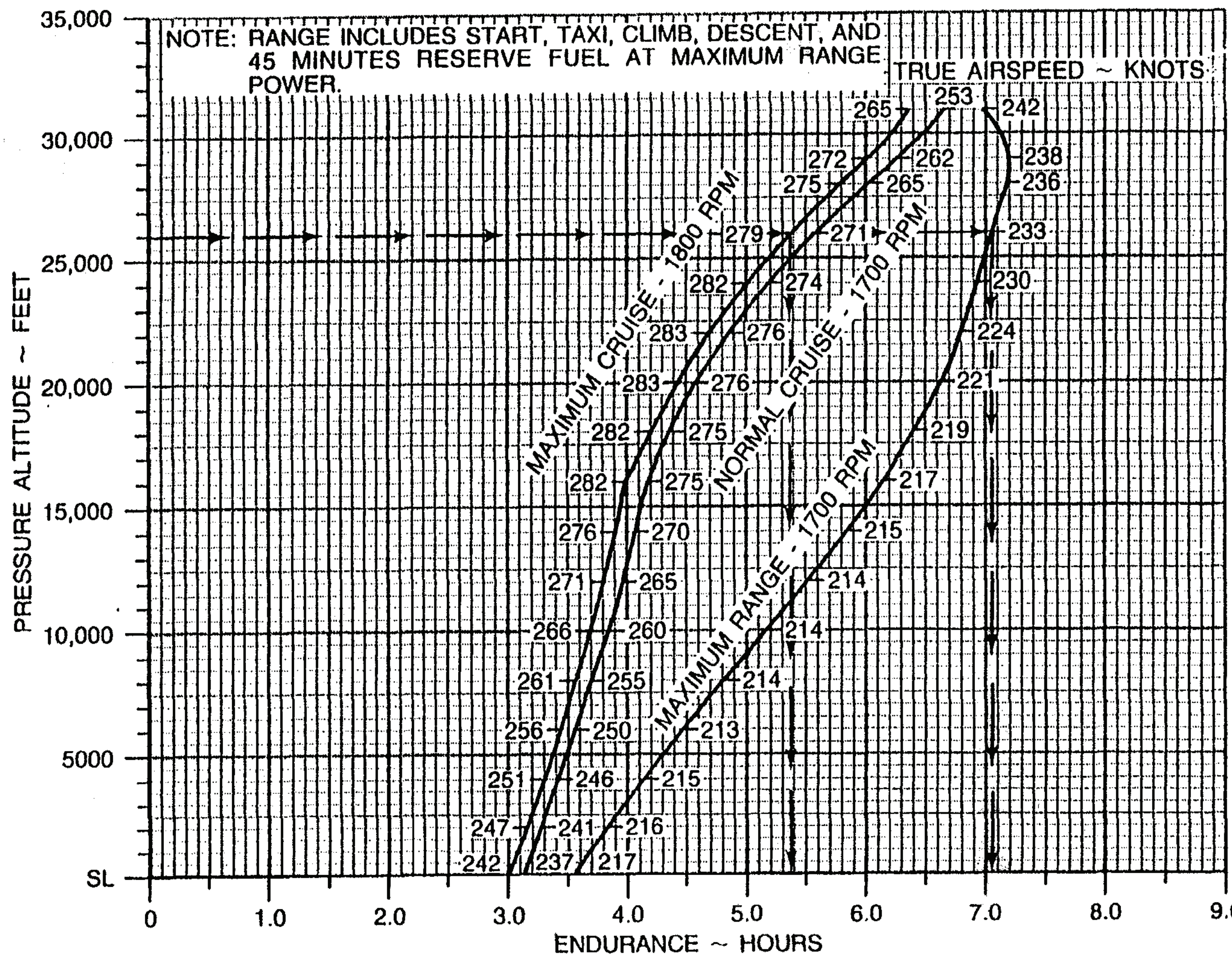


Figure 7-92. Endurance Profile – Full Main and Auxiliary Tanks

RANGE PROFILE - FULL MAIN TANKS

STANDARD DAY
ZERO WIND

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT

RANGE @ MAX CRUISE - 1800 RPM .... 968 NM
RANGE @ MAX RANGE - 1700 RPM .... 1065 NM

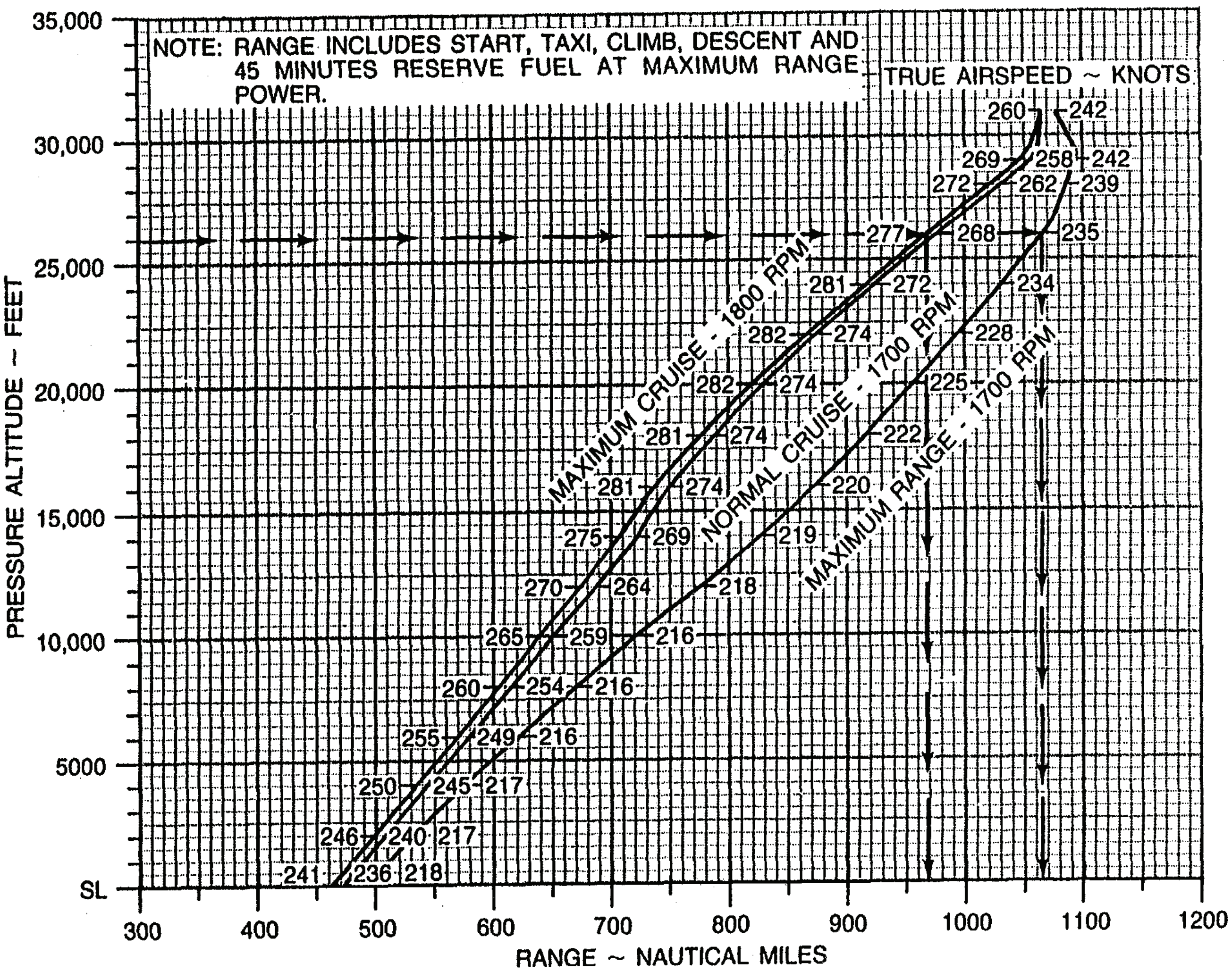


Figure 7-93. Range Profile – Full Main Tanks

ENDURANCE PROFILE - FULL MAIN TANKS

STANDARD DAY

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT

RANGE @ MAX CRUISE - 1800 RPM .... 3.62 HRS
RANGE @ MAX RANGE - 1700 RPM .... 4.57 HRS

NOTE: RANGE INCLUDES START, TAXI, CLIMB, DESCENT, AND 45 MINUTES RESERVE FUEL AT MAXIMUM RANGE POWER.

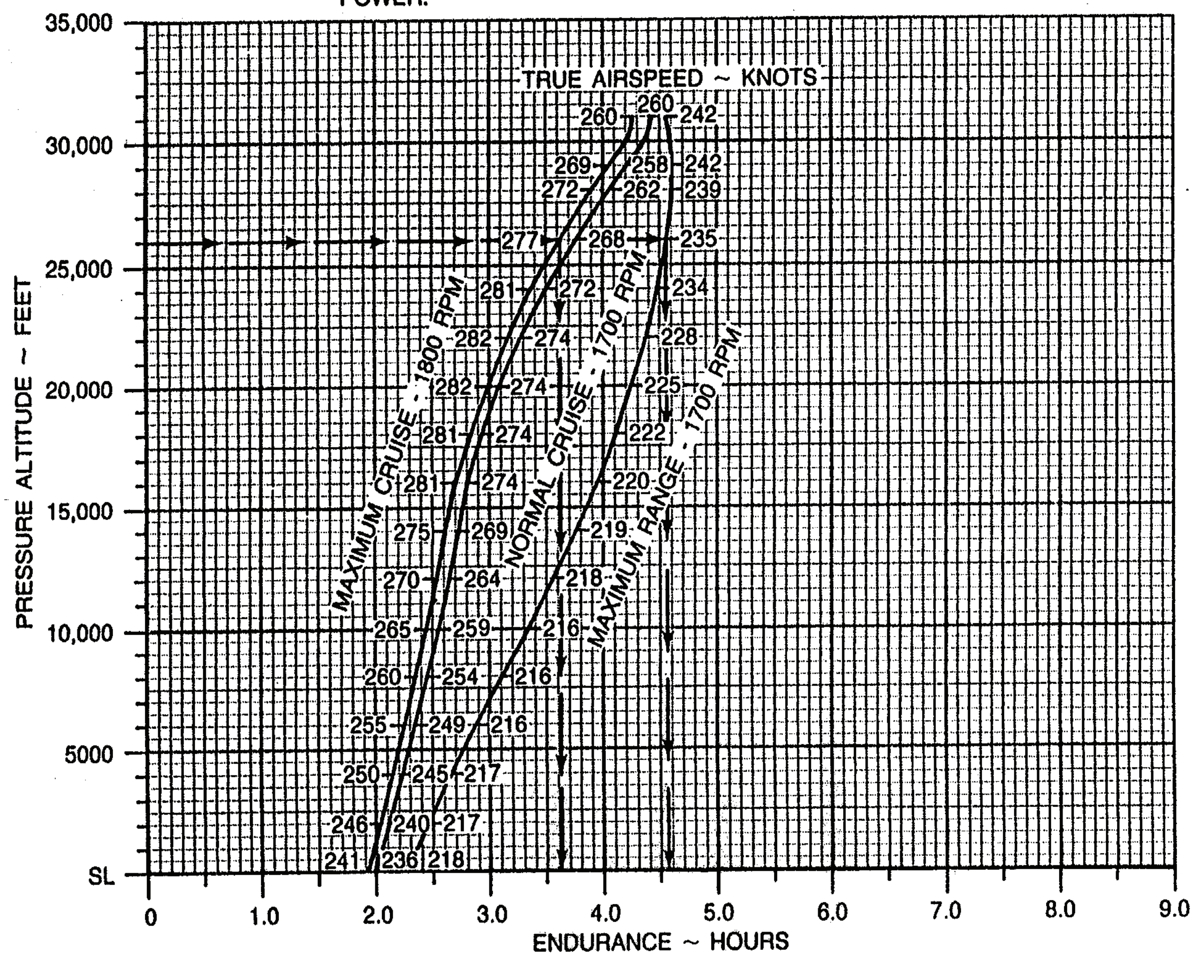


Figure 7-94. Endurance Profile – Full Main Tanks

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA – 30 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-12-	-15	2230	100	517	189	180	191	182	193	183	194	185
2000	-16	-19	2230	100	505	186	182	189	185	191	187	192	188
4000	-20	-23	2230	100	492	184	185	186	188	188	190	190	192
6000	-24	-27	2230	100	479	181	188	184	191	186	193	188	195
8000	-27	-31	2230	100	467	179	191	182	194	184	196	186	198
10,000	-31	-35	2230	100	455	176	194	179	197	182	199	184	202
12,000	-35	-39	2230	100	445	174	196	177	200	179	203	181	205
14,000	-39	-43	2230	100	439	171	199	174	203	177	206	179	208
16,000	-43	-47	2230	100	434	167	202	171	206	174	209	176	212
18,000	-47	-51	2141	96	415	160	199	165	205	169	209	172	213
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-95. Maximum Cruise Power, 1900 RPM, ISA – 30 °C

ONE ENGINE INOPERATIVE MAXIMUM CRUISE POWER 1900 RPM ISA – 20 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-2	-5	2230	100	520	187	181	189	184	191	185	193	187
2000	-6	-9	2230	100	505	185	184	187	187	189	189	191	190
4000	-10	-13	2230	100	492	182	187	185	190	187	192	189	194
6000	-13	-17	2230	100	480	180	190	182	193	184	195	186	197
8000	-17	-21	2230	100	468	177	193	180	196	182	198	184	201
10,000	-21	-25	2230	100	456	174	196	177	199	180	202	182	204
12,000	-25	-29	2230	100	446	171	198	175	202	177	205	179	207
14,000	-29	-33	2230	100	440	168	201	172	205	175	208	177	211
16,000	-33	-37	2163	97	423	162	199	166	204	170	209	173	212
18,000	-37	-41	2052	92	400	154	195	159	202	163	207	166	211
20,000	-41	-45	1940	87	378	144	190	151	199	156	205	160	210
22,000	-45	-49	1829	82	356	131	178	142	193	149	202	154	208
24,000	-50	-53	1673	75	326	– – –	– – –	127	179	138	194	145	203
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-96. Maximum Cruise Power, 1900 RPM, ISA – 20 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA – 10 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	8	5	2230	100	522	185	183	188	186	190	187	191	189
2000	4	1	2230	100	508	183	186	185	188	187	191	189	192
4000	0	-3	2230	100	494	180	189	183	191	185	194	187	196
6000	-3	-7	2230	100	481	178	192	181	195	183	197	185	199
8000	-7	-11	2230	100	468	175	194	178	198	181	200	183	203
10,000	-11	-15	2230	100	456	172	197	175	201	178	204	180	206
12,000	-15	-19	2230	100	446	169	200	173	204	175	207	178	209
14,000	-19	-23	2163	97	428	163	198	167	203	170	207	173	211
16,000	-23	-27	2052	92	406	155	195	160	201	165	206	167	201
18,000	-27	-31	1940	87	384	146	190	153	198	157	204	161	209
20,000	-31	-35	1851	83	365	135	182	145	194	151	202	155	208
22,000	-35	-39	1739	78	343	– – –	– – –	134	187	143	198	148	206
24,000	-39	-43	1628	73	318	– – –	– – –	– – –	– – –	132	189	140	200
26,000	-43	-47	1516	68	294	– – –	– – –	– – –	– – –	– – –	– – –	129	192
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-97. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA – 10 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	18	15	2230	100	525	184	185	186	187	188	189	190	191
2000	14	11	2230	100	511	181	188	184	190	186	192	188	194
4000	11	7	2230	100	497	179	190	181	193	184	196	186	198
6000	7	3	2230	100	483	176	193	179	196	181	199	183	201
8000	3	-1	2230	100	469	173	196	176	200	179	202	181	205
10,000	-1	-5	2230	100	457	170	199	174	202	176	206	179	208
12,000	-5	-9	2163	97	436	165	198	169	203	172	207	174	210
14,000	-9	-13	2074	93	412	157	195	162	201	166	206	169	209
16,000	-13	-17	1962	88	390	148	190	154	198	159	204	163	208
18,000	-17	-21	1851	83	369	138	183	146	194	152	201	156	206
20,000	-21	-25	1762	79	351	119	163	137	188	145	198	150	205
22,000	-26	-29	1650	74	329	– – –	– – –	123	175	136	193	143	202
24,000	-30	-33	1539	69	305	– – –	– – –	– – –	– – –	123	180	133	196
26,000	-33	-37	1450	65	283	– – –	– – –	– – –	– – –	– – –	– – –	121	185
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-98. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA + 10 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	28	25	2230	100	527	182	187	185	189	187	191	189	193
2000	24	21	2230	100	513	180	189	182	192	185	194	186	196
4000	21	17	2230	100	499	177	192	180	195	182	198	184	200
6000	17	13	2230	100	484	174	195	177	198	180	200	182	203
8000	13	9	2230	100	470	171	197	174	201	177	204	179	207
10,000	9	5	2119	95	441	164	195	168	199	171	203	174	207
12,000	5	1	2029	91	415	157	192	161	198	165	202	168	206
14,000	1	-3	1940	87	395	149	189	155	196	160	202	163	206
16,000	-3	-7	1873	84	376	141	184	148	194	153	201	158	206
18,000	-7	-11	1784	80	355	128	173	140	189	147	198	151	205
20,000	-12	-15	1695	76	338	---	---	130	182	139	195	145	203
22,000	-15	-19	1606	72	319	---	---	---	---	128	186	137	198
24,000	-19	-23	1494	67	296	---	---	---	---	---	---	126	190
26,000	---	---	---	---	---	---	---	---	---	---	---	---	---
28,000	---	---	---	---	---	---	---	---	---	---	---	---	---
29,000	---	---	---	---	---	---	---	---	---	---	---	---	---
31,000	---	---	---	---	---	---	---	---	---	---	---	---	---
33,000	---	---	---	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---	---	---	---

Figure 7-99. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA + 10 °C

ONE ENGINE INOPERATIVE MAXIMUM CRUISE POWER 1900 RPM ISA + 20 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	38	35	2230	100	530	181	188	183	191	185	193	187	195
2000	35	31	2230	100	515	178	191	181	194	183	196	185	198
4000	31	27	2230	100	500	176	194	178	197	181	200	183	202
6000	27	23	2163	97	475	170	193	173	197	176	200	178	203
8000	23	19	2052	92	447	163	191	167	196	170	200	173	203
10,000	19	15	1962	88	418	155	188	160	194	164	198	167	202
12,000	15	11	1873	84	394	148	185	153	192	158	197	161	202
14,000	11	7	1829	82	376	140	180	147	190	153	197	157	202
16,000	7	3	1762	79	359	129	172	140	187	147	196	152	202
18,000	2	-1	1695	76	343	---	---	132	182	141	194	146	201
20,000	-1	-5	1628	73	327	---	---	---	---	133	189	140	199
22,000	-6	-9	1539	69	307	---	---	---	---	120	178	132	195
24,000	-9	-13	1427	64	285	---	---	---	---	---	---	120	184
26,000	---	---	---	---	---	---	---	---	---	---	---	---	---
28,000	---	---	---	---	---	---	---	---	---	---	---	---	---
29,000	---	---	---	---	---	---	---	---	---	---	---	---	---
31,000	---	---	---	---	---	---	---	---	---	---	---	---	---
33,000	---	---	---	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---	---	---	---

Figure 7-100. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA + 20 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA + 30 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	48	45	2163	97	521	176	186	179	189	182	192	184	194
2000	44	41	2096	94	499	172	187	175	190	178	193	180	196
4000	40	37	2052	92	478	167	188	171	192	174	195	177	198
6000	37	33	2007	90	453	162	187	166	192	169	195	172	199
8000	33	29	1918	86	425	154	184	159	190	163	194	166	198
10,000	28	25	1829	82	397	146	180	152	187	157	193	160	198
12,000	24	21	1739	78	375	137	175	145	185	151	192	155	197
14,000	20	17	1695	76	358	126	166	138	182	145	191	150	197
16,000	16	13	1628	73	342	– – –	– – –	130	177	139	189	145	197
18,000	13	9	1606	72	329	– – –	– – –	– – –	– – –	133	187	140	196
20,000	8	5	1561	70	316	– – –	– – –	– – –	– – –	125	181	134	195
22,000	5	1	1472	66	297	– – –	– – –	– – –	– – –	– – –	– – –	125	189
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-101. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA + 30 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA + 37 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE		TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
						13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	FT-LB	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	55	52	2007	90	503	170	181	173	185	176	188	178	190
2000	51	48	1962	88	481	165	182	169	186	172	189	174	192
4000	47	44	1940	87	461	161	182	165	187	168	191	171	194
6000	43	40	1873	84	438	155	181	160	187	163	190	167	195
8000	39	36	1806	81	411	147	178	153	185	158	190	161	194
10,000	35	32	1717	77	384	138	172	146	182	151	189	156	194
12,000	31	28	1650	74	363	127	164	139	179	145	187	150	193
14,000	27	24	1606	72	346	– – –	– – –	131	175	140	186	145	193
16,000	23	20	1561	70	331	– – –	– – –	120	166	133	183	140	192
18,000	19	16	1516	68	318	– – –	– – –	– – –	– – –	126	179	135	191
20,000	16	12	1494	67	306	– – –	– – –	– – –	– – –	– – –	– – –	129	189
22,000	12	8	1405	63	289	– – –	– – –	– – –	– – –	– – –	– – –	120	182
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-102. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA + 37 °C

PRESSURIZATION CONTROLLER SETTING FOR LANDING

EXAMPLE

ALTIMETER SETTING. . . . . 29.52 IN. HG
LANDING FIELD ELEVATION . . . 2000 FT
CABIN ALTITUDE SETTING . . . . 2885 FT

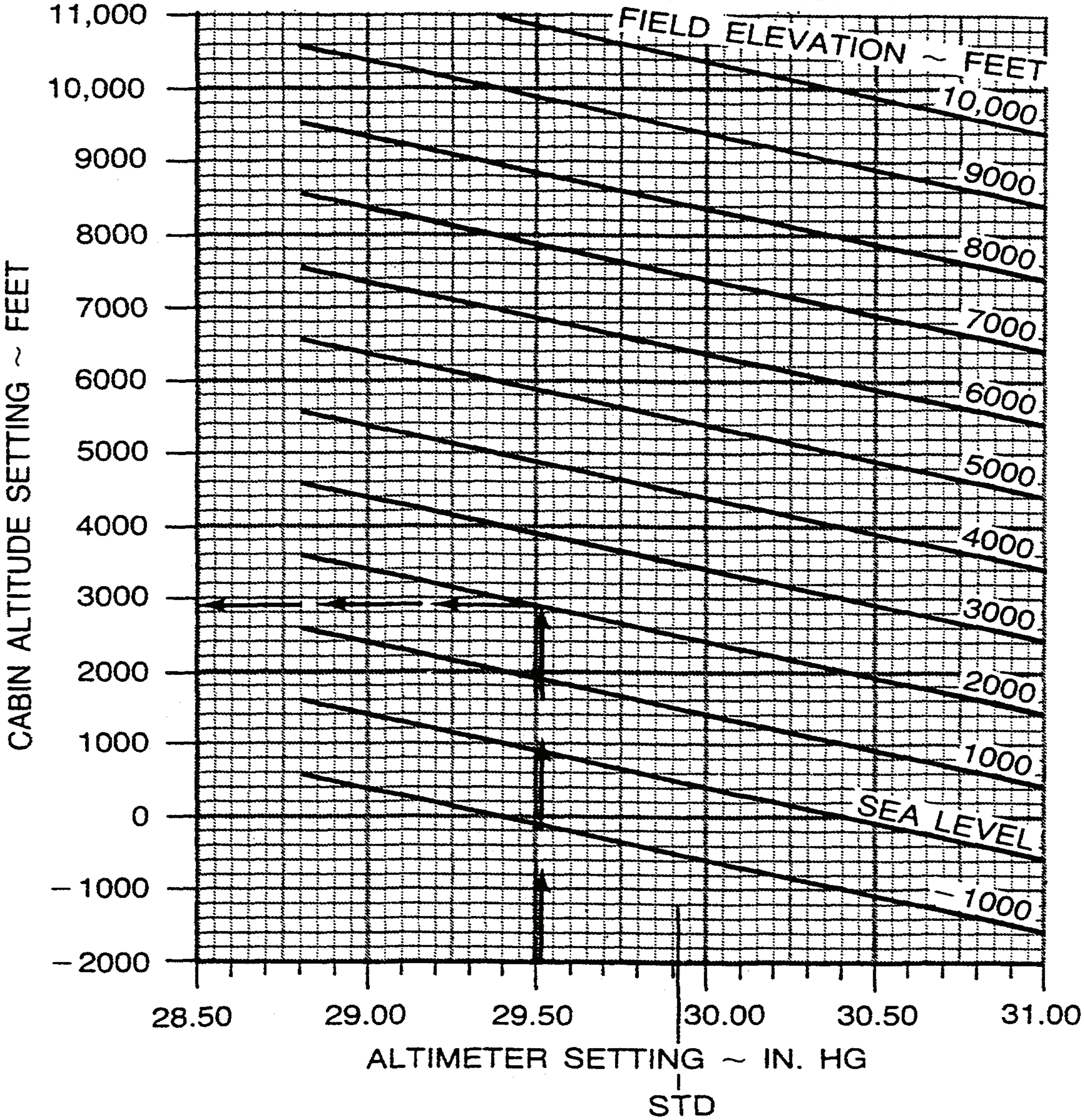


Figure 7-103. Pressurization Controller Setting for Landing

HOLDING TIME

POWER SETTING
36% AT 1700 RPM

APPLICABLE FOR ALL TEMPERATURES

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, HOLDING TIME WILL BE REDUCED APPROXIMATELY 15%.

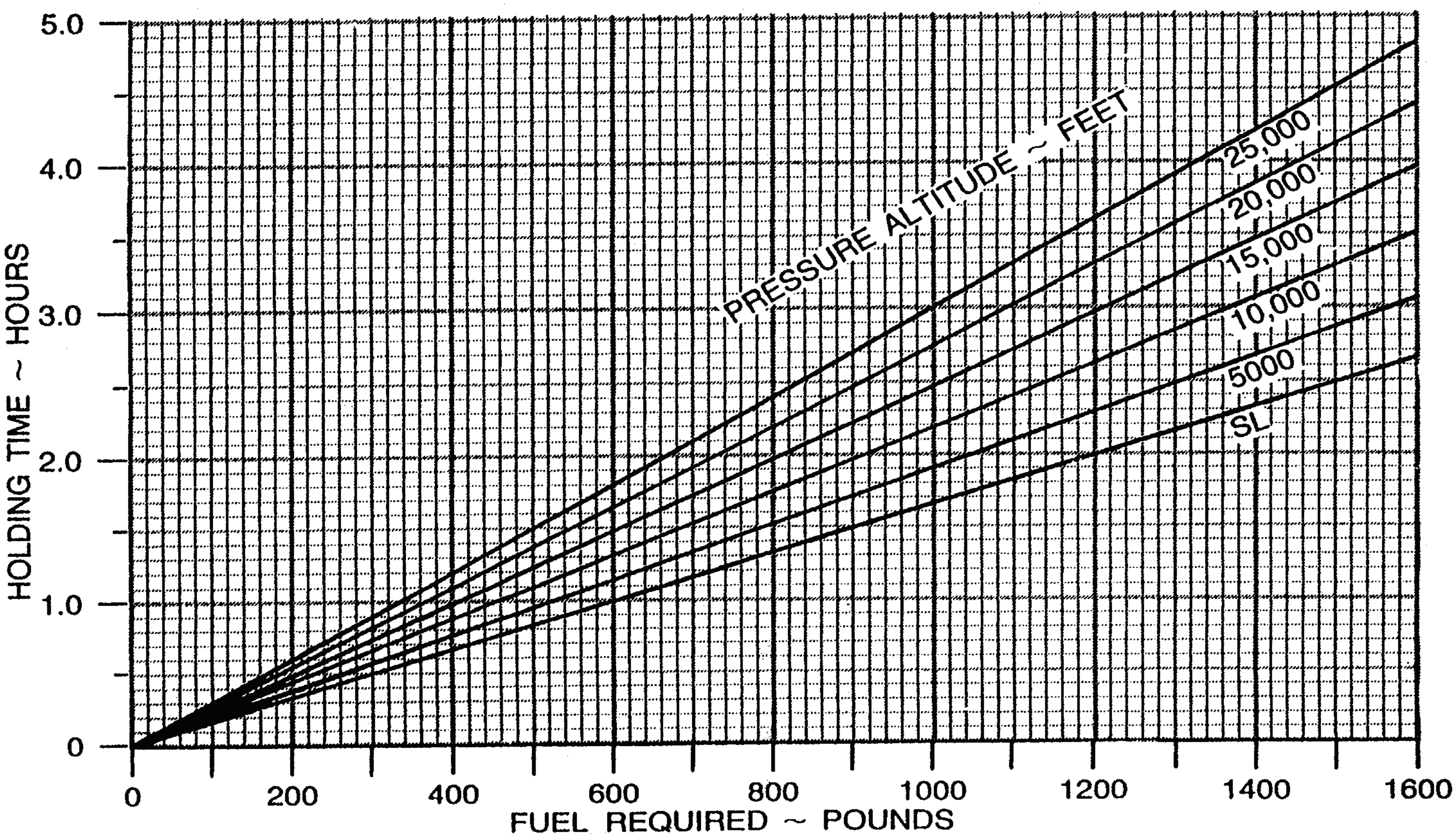


Figure 7-104. Holding Time

TIME, FUEL, AND DISTANCE TO DESCEND

ASSOCIATED CONDITIONS:

POWER .... AS REQUIRED TO DESCEND AT 1500 FT/MIN
GEAR .... UP
FLAPS .... UP

EXAMPLE:

INITIAL ALTITUDE .... 26,000 FT
FINAL ALTITUDE .... 4732 FT

TIME TO DESCEND (17-3) .... 14 MIN
FUEL TO DESCEND (148-34) .... 114 LBS
DISTANCE TO DESCEND (78-13) ... 65 NM

DESCENT SPEED: M_{MO} OR 250 KNOTS, WHICHEVER IS LESS.

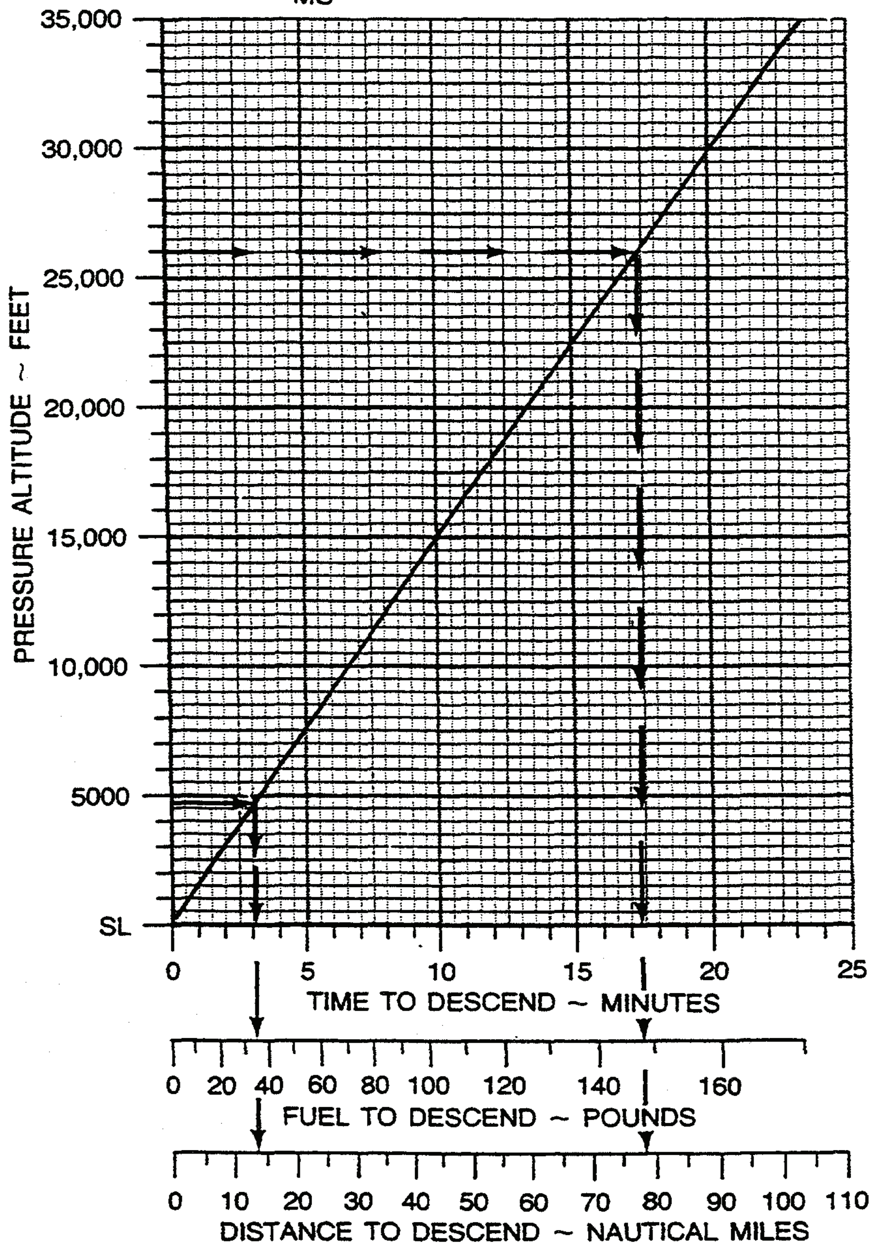


Figure 7-105. Time, Fuel, and Distance to Descend

CLIMB-BALKED LANDING

CLIMB SPEED 100 KNOTS (ALL WEIGHTS)

ASSOCIATED CONDITIONS:

POWER .... TAKE-OFF
FLAPS .... DOWN
LANDING GEAR .... DOWN

EXAMPLE:

OAT .... 32°C
PRESSURE ALTITUDE .... 4732 FT
WEIGHT .... 10,854 LBS

RATE-OF-CLIMB .... 1420 FT/MIN
CLIMB GRADIENT 14.4%

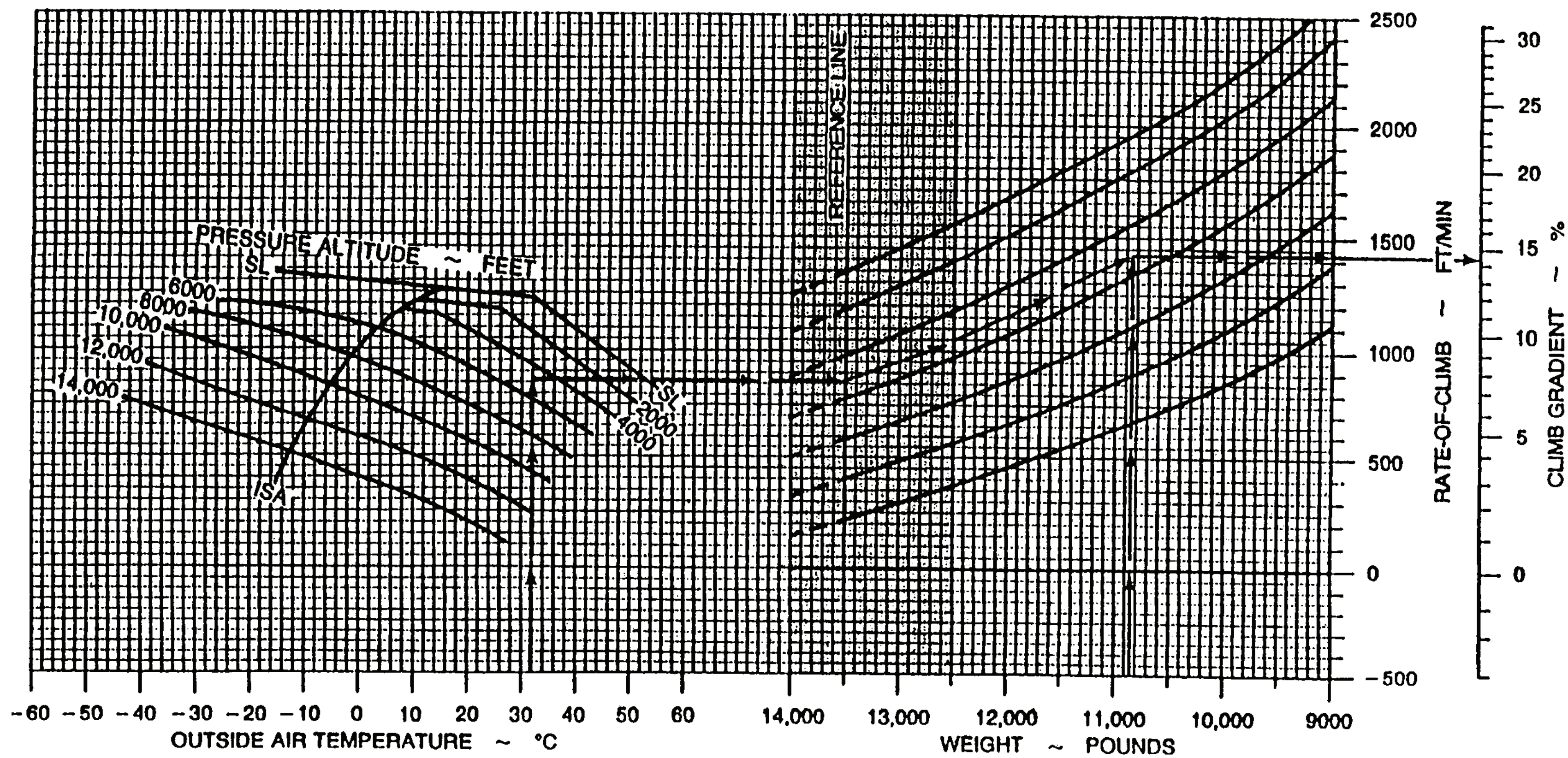


Figure 7-106. Climb – Balked Landing

NORMAL LANDING DISTANCE* WITHOUT PROPELLER REVERSING - FLAPS DOWN

ASSOCIATED CONDITIONS:

POWER............RETARDED TO MAINTAIN 800 FT/MIN ON FINAL APPROACH
FLAPS.............DOWN
RUNWAY..........PAVED LEVEL DRY SURFACE
APPROACH SPEED.IAS AS TABULATED
BRAKING ....MAXIMUM

* ADD OR SUBRACT 4% OF TOTAL GROUND ROLL FOR EACH 1% OF RUNWAY SLOPE, (DOWN - SUBTRACT, UP - ADD).

WEIGHT ~ POUNDS	APPROACH SPEED ~ KNOTS
14,000	106
13,500	105
13,000	104
12,500	102
12,000	101
11,000	99
10,000	96
9000	94

EXAMPLE:

OAT.................................32°C
PRESSURE ALTITUDE..................4732 FT
LANDING WEIGHT......................10,854 LBS
HEADWIND COMPONENT..............4.7 KTS

GROUND ROLL ....1850 FT
TOTAL OVER
50 FT OBSTACLE......................3000 FT
APPROACH SPEED....................99 KTS

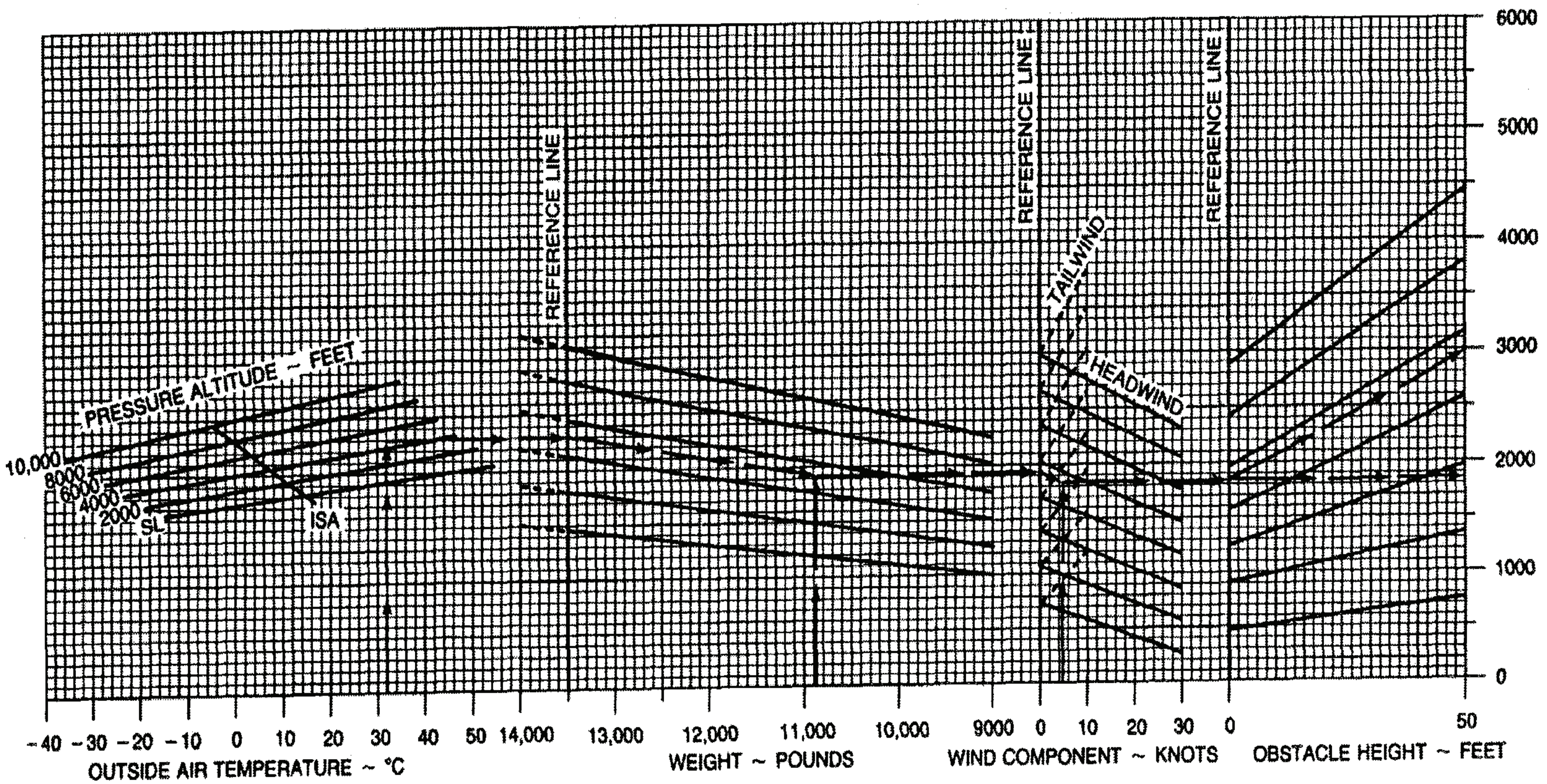


Figure 7-107. Normal Landing Distance Without Propeller Reversing, Flaps DOWN

LANDING DISTANCE WITHOUT PROPELLER REVERSING - FLAPS UP

ASSOCIATED CONDITIONS:

POWER........... RETARDED TO MAINTAIN 900 FT/MIN ON FINAL APPROACH
FLAPS............ UP
RUNWAY.......... PAVED, LEVEL, DRY SURFACE
APPROACH SPEED . IAS AS TABULATED
BRAKING .... MAXIMUM

WEIGHT ~ POUNDS	APPROACH SPEED ~ KNOTS
14,000	137
13,500	135
13,000	133
12,500	131
12,000	129
11,000	125
10,000	121
9,000	117

EXAMPLE:

FLAPS DOWN LANDING DISTANCE
OVER 50 FT OBSTACLE .... 3000 FT
LANDING WEIGHT .... 10,854 LBS

FLAPS UP LANDING DISTANCE
OVER 50 FT OBSTACLE .... 4150 FT
APPROACH SPEED .... 124 KTS

NOTES:
1. LANDING WITH FLAPS FULL DOWN IS NORMAL PROCEDURE. USE THIS GRAPH WHEN IT IS NECESSARY TO LAND WITH FLAPS UP.
2. TO DETERMINE FLAPS-UP LANDING DISTANCE, READ FROM THE **NORMAL LANDING DISTANCE WITHOUT PROPELLER REVERSING-FLAPS** DOWN GRAPH THE LANDING DISTANCE APPROPRIATE TO OAT, ALTITUDE, WEIGHT, WIND, AND 50-FT OBSTACLE. THEN ENTER THIS GRAPH WITH THE DERIVED VALUE AND READ THE FLAPS-UP LANDING DISTANCE.
3. *ADD OR SUBTRACT 5% OF TOTAL GROUND ROLL FOR EACH 1% OF RUNWAY SLOPE, (DOWN - SUBTRACT, UP - ADD).

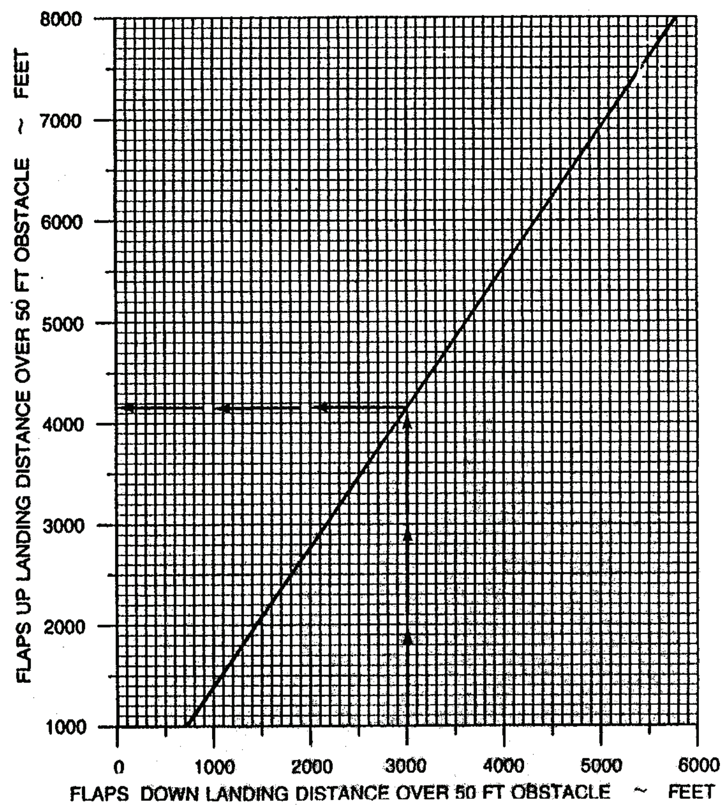


Figure 7-108. Landing Distance Without Propeller Reversing, Flaps UP

LANDING DISTANCE* WITH PROPELLER REVERSING - FLAPS DOWN

ASSOCIATED CONDITIONS:

POWER	RETARD TO MAINTAIN 1000 FT/MIN. ON FINAL APPROACH
FLAPS	DOWN
RUNWAY	PAVED, LEVEL, DRY SURFACE
APPROACH SPEED	IAS AS TABULATED
BRAKING	MAXIMUM
CONDITION LEVERS	HIGH IDLE
PROPELLER CONTROLS	FULL FORWARD
POWER LEVERS	MAXIMUM REVERSE AFTER TOUCHDOWN

WEIGHT ~ POUNDS	APPROACH SPEED ~ KNOTS
14,000	106
13,500	105
13,000	104
12,500	102
12,000	101
11,000	99
10,000	96
9000	94

EXAMPLE:

OAT	32°C
PRESSURE ALTITUDE	4732 FT
LANDING WEIGHT	10,854 LBS
HEADWIND COMPONENT	4.7 KTS
GROUND ROLL	1100 FT
TOTAL OVER 50 FT OBSTACLE	2225 FT
APPROACH SPEED	98 KTS

* ADD OR SUBTRACT 5% OF TOTAL GROUND ROLL FOR EACH 1% OF RUNWAY SLOPE, (DOWN - SUBTRACT, UP - ADD).

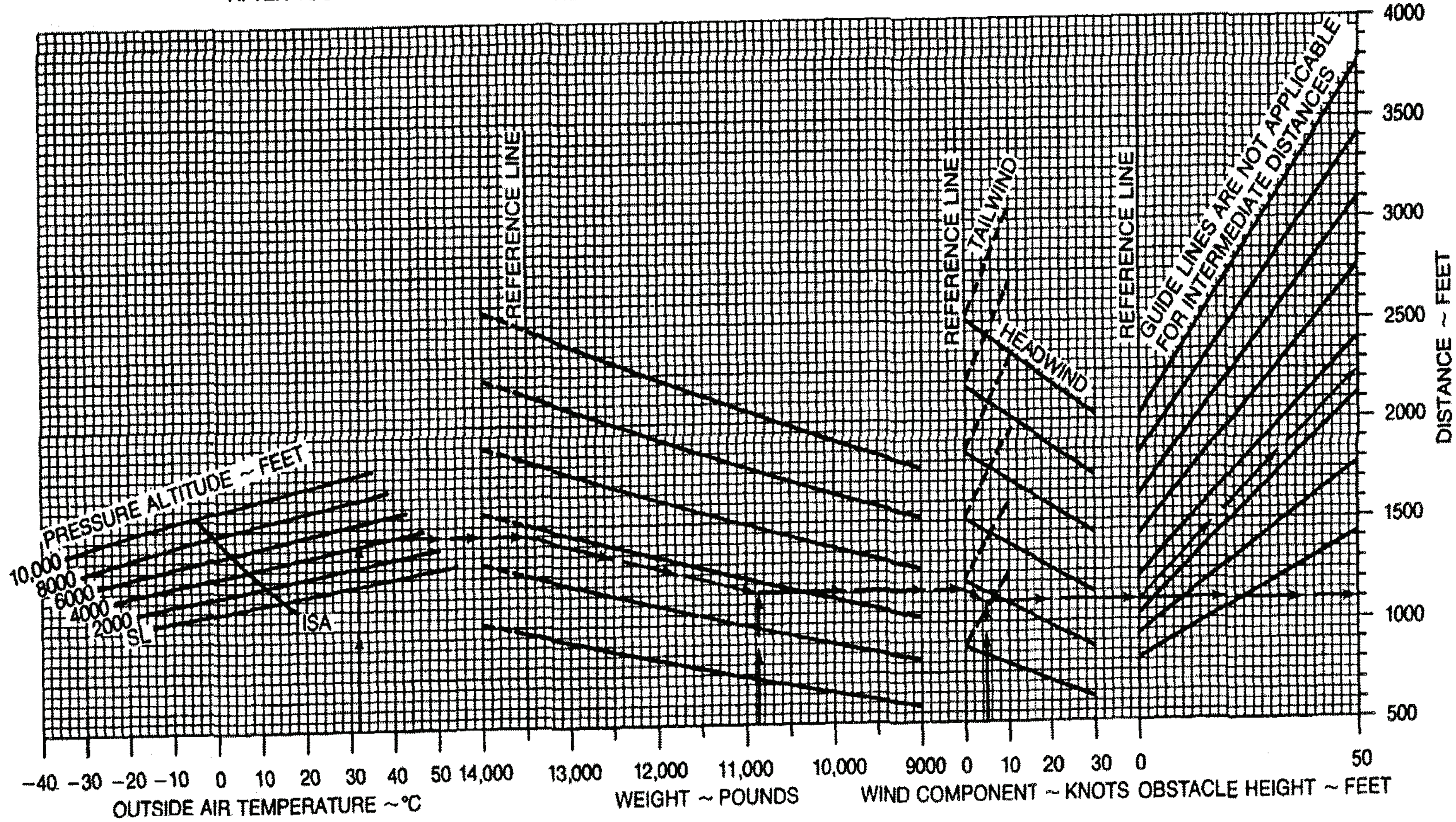


Figure 7-109. Landing Distance With Propeller Reversing, Flaps DOWN

LANDING DISTANCE WITH PROPELLER REVERSING - FLAPS UP

ASSOCIATED CONDITIONS:

POWER .... RETARD TO MAINTAIN 1000 FT/MIN ON FINAL APPROACH
FLAPS .... UP
RUNWAY .... PAVED, LEVEL, DRY SURFACE
APPROACH SPEED ... IAS AS TABULATED
BRAKING .... MAXIMUM
CONDITION LEVERS .. HIGH IDLE
PROPELLER CONTROLS .... FULL FORWARD
POWER LEVERS ..... MAXIMUM REVERSE AFTER TOUCHDOWN

WEIGHT ~ POUNDS	APPROACH SPEED ~ KNOTS
14,000	137
13,500	135
13,000	133
12,500	131
12,000	129
11,000	125
10,000	121
9000	117

EXAMPLE:

FLAPS DOWN LANDING DISTANCE OVER 50 FOOT OBSTACLE .... 2260 FT
LANDING WEIGHT .... 10,854 LBS

FLAPS UP LANDING DISTANCE OVER 50 FOOT OBSTACLE .... 2720 FT
APPROACH SPEED .... 124 KTS

NOTES:
1. LANDING WITH FLAPS FULL DOWN IS NORMAL PROCEDURE. USE THIS GRAPH WHEN IT IS NECESSARY TO LAND WITH FLAPS UP.
2. TO DETERMINE FLAPS-UP LANDING DISTANCE, READ FROM THE **LANDING DISTANCE WITH PROPELLER REVERSING – FLAPS DOWN** GRAPH THE LANDING DISTANCE APPROPRIATE TO OAT, ALTITUDE, WEIGHT, WIND, AND 50-FT OBSTACLE. THEN ENTER THIS GRAPH WITH THE DERIVED VALUE AND READ THE FLAPS-UP LANDING DISTANCE.

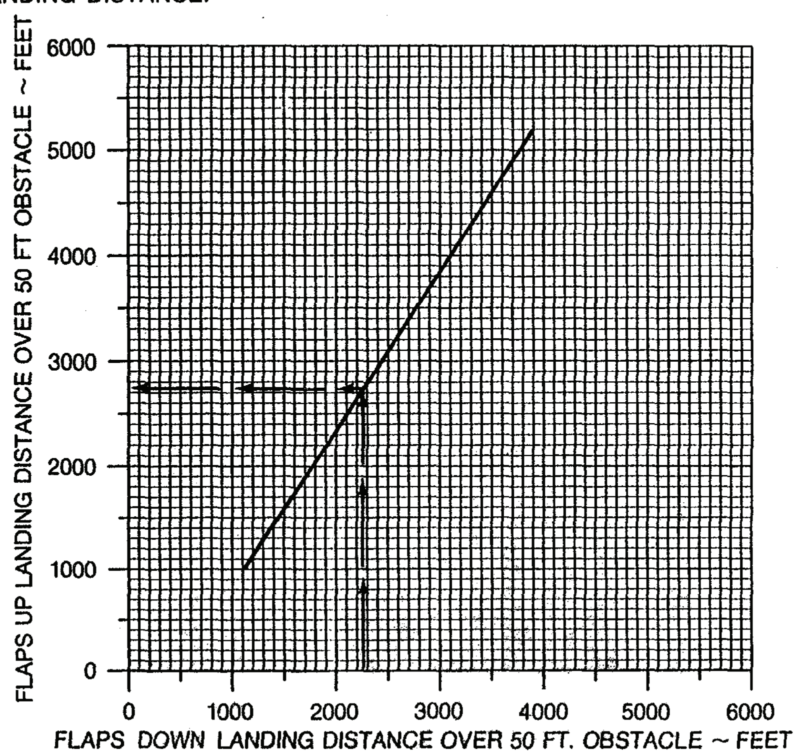


Figure 7-110. Landing Distance With Propeller Reversing, Flaps UP

STOPPING DISTANCE FACTORS

EXAMPLE:

1. ACCELERATE-STOP DISTANCE (FLAPS UP NO REV)

OAT	25 °C
PRESSURE ALTITUDE	3968 FT
HEADWIND COMPONENT	9.5 KTS
ACCELERATE-STOP DISTANCE	5400 FT
TAKE-OFF DISTANCE	3300 FT
RUNWAY CONDITION READING	10.0
TAKE-OFF WEIGHT	13,000 LB
STOPPING FACTOR	1.37
STOPPING DISTANCE ((5400 – 3300) X 1.37)	2877 FT
TAKE-OFF DISTANCE	3300 FT
NEW RCR ACCELERATE-STOP DISTANCE (2877 + 3300)	6177 FT

2. LANDING DISTANCE (FLAPS DN NO REV)

GROUND ROLL (DRY)	1700 FT
TOTAL OVER 50 FT OBSTACLE	2700 FT
RUNWAY CONDITION READING	8.0
LANDING WEIGHT	11,180 LB
STOPPING FACTOR	1.62
LANDING DISTANCE (FACTORED) GROUND ROLL (1700 X 1.62)	2754 FT
AIR DISTANCE (2700 - 1700)	1000 FT
TOTAL OVER 50 FT OBSTACLE	3754 FT

NOTE:
1. IF RCR READING IS NOT AVAILABLE, ASSUME ICY RUNWAY RCR = 5.0 AND WET RUNWAY RCR = 12.0
2. USE "NO REV" CURVE FOR ONE ENGINE REVERSING.
3. WEIGHT REFERENCE LINE IS AT 12,500 LB. FOR WEIGHT IN EXCESS OF 12,500 LB, TRACE BACK FROM THE REFERENCE LINE ALONG THE GUIDELINE TO THE HIGHER WEIGHT AND THEN OVER TO THE RCR FACTOR.

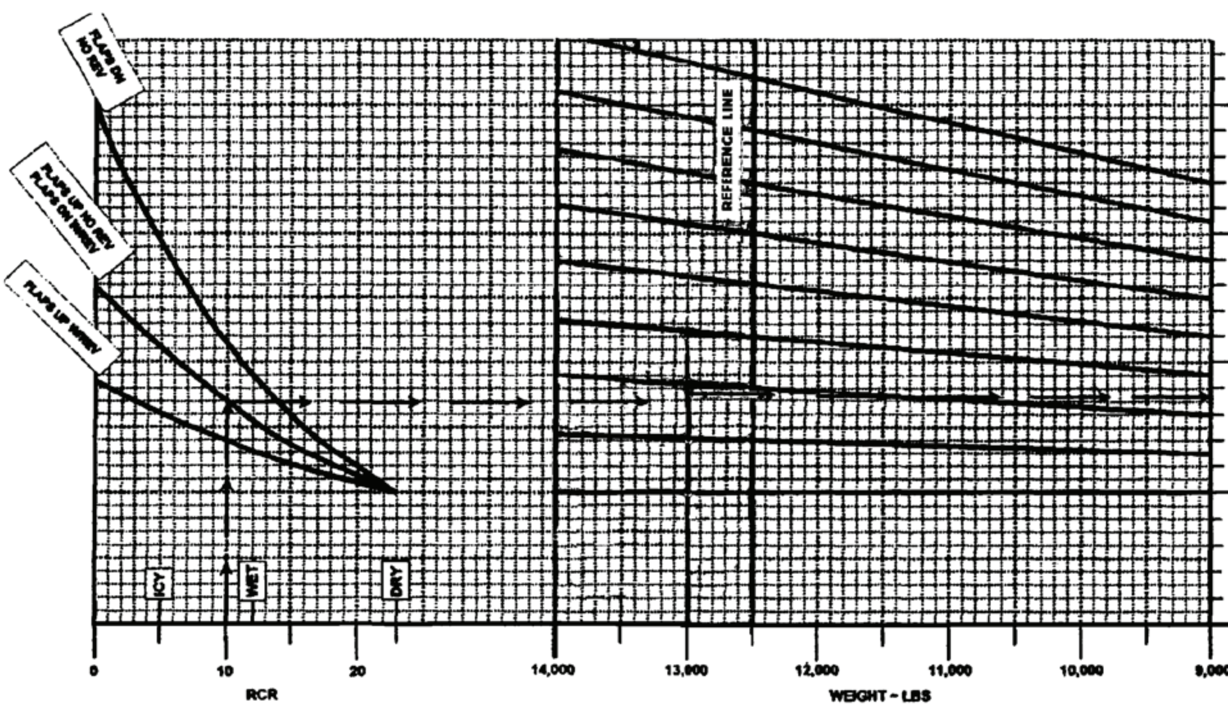


Figure 7-111. Stopping Distance Factors

CHAPTER 8
NORMAL PROCEDURES R

Section I. MISSION PLANNING

8-1. MISSION PLANNING.

Mission planning begins when the mission is assigned and extends to the preflight check of the aircraft. It includes, but is not limited to, checks of operating limits and restrictions; weight/balance and loading; performance; publications; flight plan; and crew/passenger briefings.

8-2. OPERATING LIMITS AND RESTRICTIONS.

The minimum, maximum, normal, and cautionary operational ranges represent careful aerodynamic and structural calculations, substantiated by flight test data. These limitations must be adhered to during all phases of the mission. Refer to Chapter 5, Operating Limits And Restrictions, for detailed information.

8-3. WEIGHT/BALANCE AND LOADING.

The aircraft must be loaded, cargo and passengers secured, and weight and balance verified per Chapter 6, Weight/Balance and Loading.

8-4. PERFORMANCE.

Refer to Chapter 7, Performance Data, to determine the capability of the aircraft for the entire mission. Consideration must be given to changes in performance resulting from variation in loads, temperatures, and pressure altitudes.

8-5. FLIGHT PLAN.

A flight plan must be completed and filed per AR 95-1, DoD FLIP, and local regulations.

8-6. CREW AND PASSENGER BRIEFINGS.

A crew/passenger briefing must be conducted for a thorough understanding of individual and team responsibilities. The briefing should include, but not be limited to, copilot and ground crew responsibilities and the coordination necessary to complete the mission most efficiently. A review of visual signals is desirable when ground guides do not have a direct voice communications link with the crew. Refer to Section VI for crew and passenger briefings.

Section II. OPERATING PROCEDURES AND MANEUVERS

8-7. OPERATING PROCEDURES AND MANEUVERS.

This section deals with normal procedures and includes all steps necessary for safe and efficient operation of the aircraft from the time a preflight begins until the flight is completed and the aircraft is parked and secured. Unique feel, characteristics, and reaction of the aircraft during various phases of operation and the techniques and procedures used for taxiing, takeoff, climb, etc., are described, including precautions to be observed. Only the duties of the minimum crew necessary for the actual operation of the aircraft are included.

8-8. ADDITIONAL DATA.

Procedures specifically related to instrument flight that are different from normal procedures are covered in this section following normal procedures. Descriptions of functions, operations, and effects of controls are covered in Section IV, Flight Characteristics, and are repeated in this section only when required for emphasis. Checks that must be made under adverse environmental conditions, such as desert and cold weather operations, supplement normal procedures checks in this section and are covered in Section V, Adverse Environmental Conditions. Additional crew duties are covered as necessary in Section VI, Crew Duties.

8-9. CHECKLIST.

Normal procedures are given primarily in checklist form and are amplified as necessary in accompanying paragraph form when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operator's and Crewmember's Checklist, TM 1-1510-225-CL. To provide for easier cross referencing, the procedural steps in the checklist are numbered to coincide with the correspondingly numbered steps in this manual.

8-10. USE OF CHECKLIST.

Although a good working knowledge of all aircraft procedures is desirable, it is not mandatory that they be committed to memory. The pilot is responsible for the initiation and accomplishment of all required checks. Checklist items will be called out orally and the action verified using the checklist (-CL). Normally, the pilot not flying (PNF) will call out the checklist, both challenge and response, and perform such duties as directed by the pilot flying (PF). "As required" will not be used as a response; instead the actual position or setting of the unit or item, such as "On" or "Up" or "Approach" will be stated. Upon completion of each checklist, the crewmember reading the checklist will announce "Checklist complete."

8-11. CHECKS.

a. Listed below are the symbols used in the following procedures and their associated meanings.

N — Indicates performance of step is mandatory for night flights.

I — Indicates a mandatory check for instrument flights.

O — Indicates if installed.

★ — Indicates an operational check contained in the performance section of the condensed checklist.

* — Indicates performance of step is mandatory for all through flights. The asterisk applies only to checks performed prior to takeoff.

b. Placarded items such as switch and control positions appear in boldface capital letters.

8-12. BEFORE EXTERIOR CHECK.

* 1. Forms/publications – Check DA Forms 2408 -12, -13, -14, and -18, DD Form 365-4, locally required forms and publications, and availability of operator's manual (-10) and checklist (-CL).

2. Toilet – Check.

3. Emergency equipment – Check that all required emergency equipment is available and that fire extinguishers and first aid kits have current inspection date.

   a. Survival kits (3).

   b. First aid kits (3).

   c. Baggage compartment fire extinguisher.

   d. Overhead emergency lighting (forward and aft).

   e. Emergency exit.

   f. Cockpit fire extinguisher.

* 4. **LDG GEAR CONTROL** – **DN**.

* 5. Manual gear extension handle – Down and latched.

* 6. Parking brake – Set.

7. Flight controls – Check.

8. Manual trim – Check and set to zero.

* 9. **IGNITION AND ENGINE START** switches – **OFF**.

* 10. Circuit breakers – Check in.

★ 11. Fuel system – Check.

   a. Fuel **FIREWALL SHUTOFF VALVES** – **CLOSED**.

   b. **STANDBY PUMPS – ON.**

   c. **BATT** switch – **ON** (**L** and **R FUEL PRESS**, **L** and **R ENG ANT-ICE** annunciators illuminated).

   d. **L** and **R FUEL PRESS** annunciators – Illuminated.

   e. Fuel **FIREWALL SHUTOFF VALVES** – **OPEN**.

   f. **L** and **R FUEL PRESS** annunciators – Extinguished.

   g. **STANDBY PUMPS – OFF.**

   h. **L** and **R FUEL PRESS** annunciators – Illuminated.

   i. **CROSSFEED FLOW** alternately **LEFT** and **RIGHT (FUEL CROSSFEED** annunciator illuminated, **L AND R FUEL PRESS** annunciators extinguished).

   j. **CROSSFEED FLOW – OFF.**

   k. Auxiliary fuel transfer – **AUTO**.

   l. **NO TRANSFER** lights – **TEST**.

   m. Fuel quantity – Check.

12. Exterior lights and heat – Check.

   a. Navigation, recognition, beacons, strobes, door entry light, logo light, landing, and taxi lights – Check on, then **OFF**.

b. Pitot (2), stall warning, and fuel vent heat (2) – Check on, then **OFF**.

13. Cabin door annunciator light – Check on.

★ 14. Oxygen system – Check. Refer to Table 8-1, Oxygen Duration.

a. Passenger manual drop-out – Push off.

b. Oxygen system – Crew ready.

c. Crew masks – **100%**; check operation and stow.

NOTE

1850 psi at 15° is a fully charged bottle. Read duration directly from Table 8-1.

(1) Read oxygen pressure from the gauge.

(2) Read the OAT (with battery on).

(3) Determine the percent of usable capacity from Figure 8-1 (e.g., 1100 psi at 0°C = 57%).

(4) Compute the oxygen duration in minutes from Table 8-1 by multiplying the full bottle duration by the percent of usable capacity, as in the following example.

(a) Pilot and copilot with masks set at **100%** plus 6 passengers = 10 people using oxygen.

NOTE

For oxygen duration computations, count each diluter-demand crew mask in use as two (e.g., with four passengers and a crew of two, enter the table at eight people using).

(b) Cylinder volume =115 cubic feet.

(c) Duration with full bottle = 73 minutes.

(d) Duration with 57% capacity: .57 x 73 = 41 minutes.

15. Annunciator lights – Check.

16. Hydraulic fluid sensor – Check.

17. Fire detection system – Check.

18. Fire extinguishers – **TEST**.

19. Stall and landing gear warning – Check.

20. **FLAPS** – As desired.

21. **ENGINE ANTI-ICE** – As desired.

22. **BATT** switch – **OFF**.

23. **EFIS AUX POWER** – Test.

a. **TEST** switch – Hold to **TEST** for 5 seconds (green **TEST** annunciator will illuminate for 5 seconds).

b. **TEST** switch – Release.

8-13. FUEL SAMPLE AND OIL CHECK.

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

NOTE

Fuel and oil quantity checks may be performed prior to Exterior Check to preclude carrying a ladder and fuel sample container during the balance of the preflight. During warm weather, open fuel caps slowly to prevent being sprayed by fuel under pressure.

1. Fuel sample – Check collective fuel sample from all drains for possible contamination. (Refer to Chapter 2 for locations.)

Table 8-1. Oxygen Duration

OXYGEN DURATION WITH FULL BOTTLE (100% CAPACITY)									
STATED CYLINDER SIZE (CU FT)	**NUMBER OF PEOPLE USING								
	1	2	3	4	5	6	7	8	9
	DURATION IN MINUTES								
22	144	72	48	36	26	24	20	18	16
50	317	158	105	79	63	52	45	39	35
77	488	244	182	122	97	81	69	61	54
115	732	366	244	183	146	122	104	91	81
STATED CYLINDER SIZE (CU FT)	**NUMBER OF PEOPLE USING								
	10	11	12	13	14	15	**16	**17	
	DURATION IN MINUTES								
22	14	13	12	11	10	*	*	*	
50	31	28	26	24	22	21	19	18	
77	48	44	40	37	34	32	30	28	
115	73	66	61	56	52	48	45	43	

* Will not meet oxygen requirements.

** For oxygen duration computations, count each diluter-demand crew mask in use as two (e.g., with four passengers and a crew of two, enter the table at eight people using).

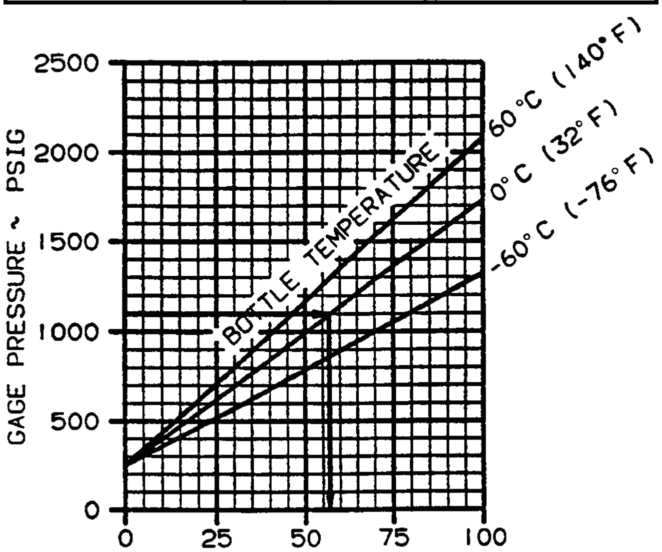


Figure 8-1. Percent of Usable Capacity

NOTE

All exterior check areas are illustrated in Figure 8-2.

8-14. LEFT WING, AREA 1.

1. Left wing area – Check as follows:

* a. General condition – Check for skin damage such as buckling, splitting, distortion, dents, or fuel leaks.

b. Flaps – Check for full extension or retraction (approximately 1/4 inch play) and skin damage, such as buckling, splitting, distortion or dents.

c. Fuel sump drains – Check for leaks.

d. Ailerons and trim tab – Check security and trim tab rig.

e. Static wicks – Check security and condition.

f. Wing tip and position lights – Check condition and for cracked lens.

g. Recognition/strobe light – Check condition.

h. Outboard wing fuel vent – Check free of obstruction.

* i. Main tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

j. Outboard deice boot – Check for secure bonding, cracks, loose patches, stall strip.

k. Stall warning vane – Check free.

* l. Tiedown – Released.

m. Wing ice light – Check condition.

n. Recessed and heated fuel vents – Check free of obstructions.

2. Left main landing gear – Check as follows:

* a. Tires – Check for cuts, bruises, wear, appearance of proper inflation, wheel condition, and that both tires have the same tread design.

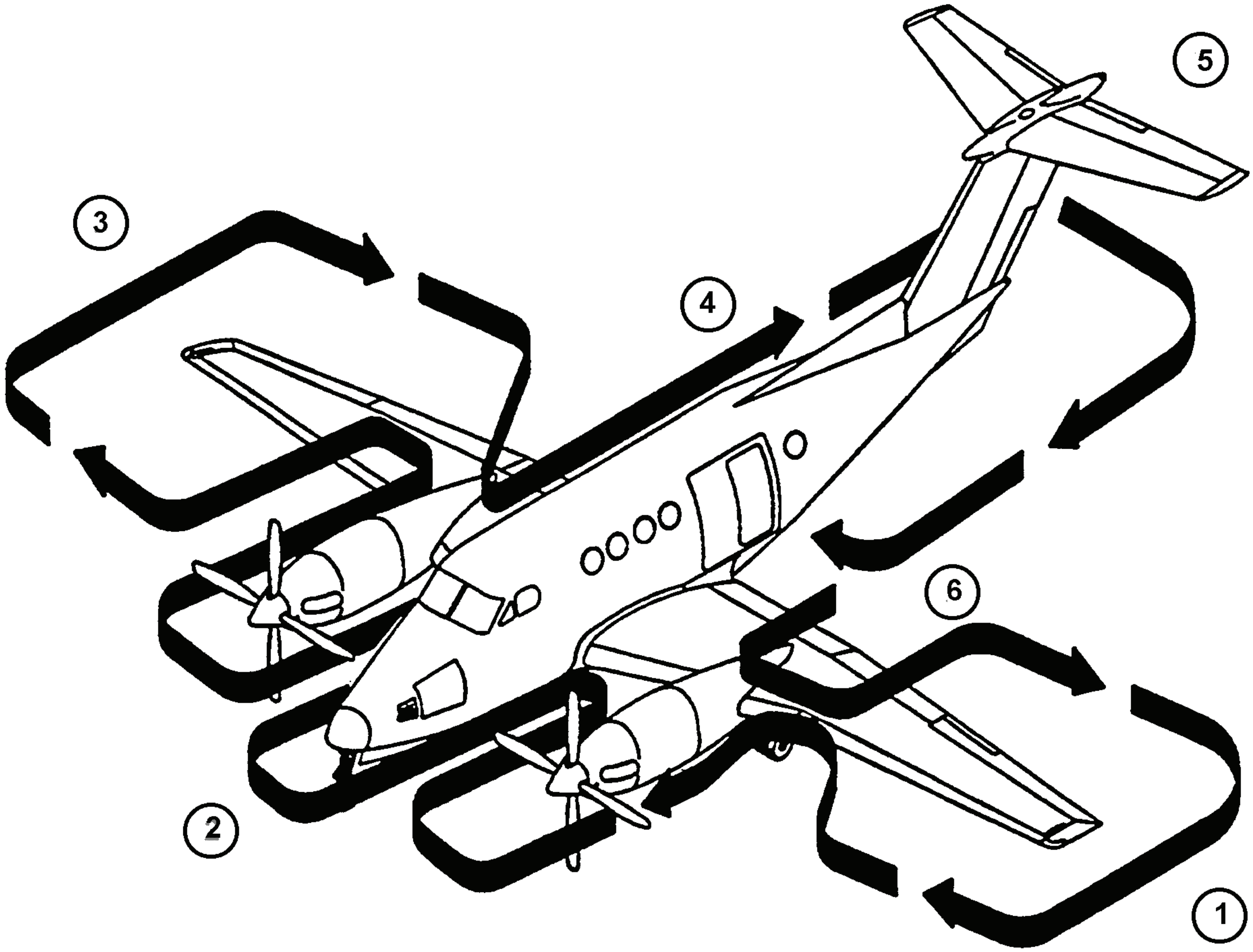
b. Brake assembly – Check brake lines for damage or signs of leakage, and brake linings for wear. Also check the brake deice assembly and bleed air hose for condition and security.

* c. Shock strut – Check for signs of leakage, minimum strut extension (5.5 inches), and left and right extension is approximately equal.

d. Torque knee – Check condition.

e. Safety switch – Check condition, wire, and security.

★ f. Fire extinguisher pressure – Check within limits. Refer to Chapter 2.



AREA 1	LEFT WING LANDING GEAR, ENGINE, NACELLE, AND PROPELLER
AREA 2	NOSE SECTION
AREA 3	RIGHT WING LANDING GEAR, ENGINE, NACELLE, AND PROPELLER
AREA 4	FUSELAGE, RIGHT SIDE
AREA 5	EMPENNAGE
AREA 6	FUSELAGE, LEFT SIDE

Figure 8-2. Exterior Check

g. Wheel well, doors, and linkage – Check for signs of leakage, broken wires, security, and general condition.

h. Fuel sump drains – Check for leaks.

3. Left engine and propeller – Check as follows:

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

* a. Engine oil – Check oil level, no more than 3 quarts low, cap secured, and locking tab aft.

b. Engine compartment, left side – Check for fuel and oil leaks, security of oil cap, door, and general condition. Lock compartment access door.

c. Left cowl locks – Locked.

d. Left exhaust stub – Check for cracks and free of obstructions.

e. Propeller blades and spinner – Check blade condition, deice boot, security of spinner, and free propeller rotation.

f. Engine air inlets and ice vanes – Check free of obstruction and ice vane in the correct position.

g. Bypass door – Check condition and position.

h. Right cowl locks – Locked.

i. Right exhaust stub – Check for cracks and free of obstructions.

j. Engine compartment, right side – Check for fuel and oil leaks, ice vane linkage, door, and general condition. Lock compartment access door.

4. Left wing center section – Check as follows:

a. Heat exchanger inlet and outlet – Check for cracks and free of obstructions.

b. Auxiliary tank fuel sump drain – Check for leaks.

c. Hydraulic reservoir vent and pump seal drain – Check vent clear of obstructions, and no excessive fluid is present. Hydraulic landing gear service door secure.

d. Deice boot – Check for bonding, cracks, loose patches, and general condition.

* e. Auxiliary tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

5. Fuselage underside – Check as follows:

* a. General condition – Check for skin damage such as buckling, splitting, distortion, dents, or fuel leaks.

b. Antennas – Check security and general condition.

8-15. NOSE SECTION, AREA 2.

1. Nose section – Check as follows:

a. Outside air temperature probe – Check condition.

b. Avionics door, left side – Check secure.

c. Air conditioner exhaust – Check free of obstruction.

d. Wheel well condition – Check for signs of leakage, broken wires, and condition.

e. Doors and linkage – Check condition, security, and alignment.

f. Nose gear turning stop – Check condition.

* g. Tire – Check for cuts, bruises, wear, appearance of proper inflation, and wheel condition.

* h. Shock strut – Check for signs of leakage and 3 inches minimum extension.

i. Torque knee – Check condition.

j. Shimmy damper and linkage – Check for security and condition.

k. Headset jack cover – Check installed.

l. Landing and taxi lights – Check for security and condition.

m. Pitot tubes – Check covers removed, alignment, security, and free of obstructions.

n. Radome – Check condition.

CAUTION

Do not move wipers on dry windshield or clean windshield with anything other than mild soap and water.

o. Windshields and wipers – Check windshields for cracks and cleanliness, and wipers for contact with glass surface.

p. Air conditioner inlet – Check free of obstructions.

q. Avionics door, right side – Check secure.

r. TAS/CADC probe – Check security and condition.

8-16. RIGHT WING, AREA 3.

1. Right wing center section – Check as follows:

a. Deice boot – Check for secure bonding, cracks, loose patches, and general condition.

b. Battery access panel – Secure.

c. Battery exhaust louvers – Check free of obstructions.

*d. Auxiliary tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

e. Battery compartment drain – Check free of obstruction and check-valve free.

f. Battery ram air intake – Check free of obstruction.

g. Auxiliary tank fuel sump drain – Check for leaks.

h. Heat exchanger outlet and inlet – Check for cracks and free of obstructions.

2. Right engine and propeller – Check as follows:

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

*a. Engine oil – Check oil level, no more than 3 quarts low, cap secure, and locking tab aft.

b. Engine compartment, left side – Check for fuel and oil leaks, security of oil cap, door and general condition. Lock compartment access door.

c. Left cowl locks – Locked.

d. Left exhaust stub – Check for cracks and free of obstructions.

e. Propeller blades and spinner – Check blade condition, security of deice boot, spinner security, and free propeller rotation.

f. Engine air inlets and ice vane – Check free of obstruction and ice vane in the correct position.

g. Bypass door – Check condition.

h. Right Cowl Locks – Locked.

i. Right exhaust stub – Check for cracks and free of obstructions.

j. Engine compartment, right side – Check for fuel and oil leaks, ice vane linkage, door, and general condition. Lock compartment access door.

3. Right main landing gear – Check as follows:

a. Fuel sump drains – Check for leaks.

*b. Tires – Check for cuts, bruises, wear, appearance of proper inflation, wheel condition, and that both tires have the same tread design.

c. Brake assembly – Check lines for damage or signs of leakage, and brake linings for wear. Also check brake deice assembly and bleed-air hose for condition and security.

*d. Shock strut – Check for signs of leakage and minimum strut extension (5.5 inches), and left and right extension is approximately equal.

e. Torque knee – Check condition.

f. Safety switch – Check condition, wire, and security.

★ g. Fire extinguisher pressure – Check within limits. Refer to Chapter 2.

h. Wheel well, doors, and linkage – Check for signs of leakage, broken wires, security, and general condition.

4. Right wing – Check as follows:

a. Recessed and heated fuel vents – Check free of obstructions.

b. GPU access door – Secured.

c. Wing ice light – Check condition.

d. Outboard deice boot – Check for secure bonding, cracks, loose patches, stall strip, and general condition.

* e. Tiedown – Released.

* f. Main tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

g. Outboard wing fuel vent – Check free of obstruction.

h. Wing tip and position light – Check condition and for cracked lens.

i. Recognition/strobe light – Check condition.

j. Static wicks – Check security and condition.

k. Ailerons and trim tab – Check security and condition of ground adjustable tab.

l. Fuel sump drains – Check for leaks.

m. Flaps – Check for full extension or retraction (approximately 1/4 inch play) and skin damage such as buckling, splitting, distortion, or dents.

* n. General condition – Check for skin damage such as buckling, splitting, distortion, dents, or fuel leaks.

8-17. FUSELAGE RIGHT SIDE, AREA 4.

1. Fuselage right side – Check as follows:

* a. General condition – Check for skin damage such as buckling, splitting, distortion, or dents.

b. Emergency light – Check condition.

c. Beacon – Check condition.

d. Aft access door – Check condition.

e. Cabin air exhaust – Clear.

f. Oxygen filler door – Check secure.

g. Static ports – Check clear of obstructions.

h. Emergency locator transmitter – Antenna check.

8-18. EMPENNAGE, AREA 5.

1. Empennage – Check as follows:

a. Vertical stabilizer, rudder, and trim tab – Check for skin damage such as buckling, splitting, distortion, or dents, and trim tab rig.

b. Antennas – Check condition.

c. Deice boots – Check for secure bonding, cracks, loose patches, and general condition.

WARNING

If the possibility of ice accumulation on the horizontal stabilizer or elevator exists, do not take off.

d. Horizontal stabilizer, elevator, and trim tab – Check for skin damage such as buckling, splitting, distortion, or dents, and trim tab rig.

e. Elevator trim tab – Verify "0" (neutral) position. The elevator trim tab "0" (neutral) position is determined by observing that the trailing edge of the trim tab aligns with the trailing edge of the elevator while the elevator is resting against the downstops.

f. Static wicks – Check.

g. Position and beacon lights – Check condition.

8-19. FUSELAGE LEFT SIDE, AREA 6.

1. Fuselage left side – Check as follows:

* a. General condition – Check for skin damage such as buckling, splitting, distortion, or dents.

b. Static ports – Check clear of obstructions.

c. Emergency Light – Check condition.

d. Cabin door – Check seal and general condition.

e. Fuselage top side – Check general condition.

* 2. Chocks and tiedowns – Removed.

***8-20. INTERIOR CHECK.**

1. Cargo/loose equipment – Check secure.

CAUTION

Ferry fuel tank caps shall be properly secured to prevent fuel fumes from escaping into the cabin.

★ O 2. Ferry fuel tanks and caps – Visually check fuel level of each tank, condition of seal, and that cap is tight and properly installed. Check tiedowns and platform assemblies to determine if tanks are securely installed.

O 3. Ferry fuel tank selector valve(s) – Closed.

★ 4. Cabin door – Locked and checked. Ensure the cabin door is closed and locked as follows. Check position of safety arm and diaphragm plunger (lift door step) and each of the six rotary cam locks align within the orange sight indicators. In addition, the following inspection and test shall be performed prior to the first flight of the day.

a. Open cabin door – Check that **DOOR UNLOCKED** annunciator is extinguished.

b. Latch cabin door but do not lock – Check that **DOOR UNLOCKED** annunciator illuminates.

c. **BATT** switch – **ON**. Check that **DOOR UNLOCKED** annunciator is still illuminated.

d. Close and lock cabin door – Check that **DOOR UNLOCKED** annunciator is extinguished.

e. **BATT** switch – **OFF**.

5. Cargo door – Locked and checked. Ensure cargo door is closed and locked as follows:

a. Upper handle position – Closed and locked (orange index marks on each of the four rotary cam locks must align within the sight indicators).

b. Lower pin latch handle position – Closed and latched (orange indicator must align with orange stripe on carrier rod).

NOTE

The untapered shoulder of the latching pins should extend past each attachment lug.

★ 6. Crew/passenger briefing – Complete.

8-21. BEFORE STARTING ENGINES.

NOTE

GPU engine starts are the preferred starting method.

* 1. Parking brake – Set.

* 2. Oxygen system – Crew ready.

* 3. Pilot's instrument panel – Check.

a. Compass control – **SLV**.

b. **PROP SYN** switch – **ON**.

4. Pilot's clock – Check and set.

* 5. Pilot's subpanel – Check.

a. **MIC** selector switch – **NORMAL**.

b. Engine ice vanes – As required.

NOTE

The ENGINE ANTI-ICE switch should be set to ON for all ground operations to minimize ingestion of ground debris. Set switch to OFF to maintain engine temperatures within limits.

c. **PILOT AIR** control – As required.

d. **DEFROST AIR** control – As required.

e. **LDG GEAR CONTROL** – **DN**.

f. **LANDING GEAR RELAY** circuit breaker – In.

g. All other switches – Off.

* 6. Avionics panel switches – As required.

NOTE

Where excessive gravel/debris is present, or the ramp is slippery, the pilot may consider starting the engines with the props in FEATHER, but must closely monitor ITT on engine start.

* 7. Power console – Check.

a. **POWER** levers – **IDLE**.

b. **PROP** levers – As required.

c. **CONDITION** levers – **FUEL CUTOFF**.

d. Trim tabs – Set.

e. Landing gear alternate extension handle – Stowed.

* 8. Pedestal – Check.

a. **EFIS POWER** switches – **OFF**.

b. **AP/TRIM POWER** switch – **OFF**.

c. **CABIN PRESS** switch – **PRESS**.

d. **RUDDER BOOST** switch – On.

e. Pressurization controller – Set.

* 9. Copilot's instrument panel – Set.

Compass control – **SLV**.

10. Copilot's clock – Check and set.

* 11. Copilot's subpanel – Check.

a. **CABIN** signs – As required.

b. **VENT BLOWER** switch – As required.

c. **AFT BLOWER** – **OFF**.

d. **BLEED AIR VALVES** switches – **ENVIR OFF**.

e. **CABIN TEMP MODE** control – **OFF**.

f. **CABIN/COCKPIT AIR** control – **OFF**.

g. **COPILOT AIR** control – As required.

h. **MIC** selector switch – **NORMAL**.

i. Oxygen pressure – Check.

* 12. Copilot's circuit breaker panel – Check.

13. Static air source – Normal.

* 14. **BATT** – **ON** (23 volts minimum for battery start, 20 volts for GPU start).

15. Overhead panel lights – As required.

16. Exterior lights – As required.

CAUTION

Never connect an external power source to the aircraft unless a battery indicating a charge of at least 20 volts is in the aircraft and in the ON position. If the battery voltage is less than 20 volts, the battery must be recharged, or replaced with a battery indicating at least 20 volts before connecting external power. Use only an external power source fitted with an AN-type plug.

17. GPU – As required.

18. External power advisory light – As required.

19. DC volt/loadmeters – Check loads, voltage, and current limiters.

When an external power source is used, it must be set as follows:

28.0 to 28.4 volts

1000 amps capacity

300 amps maximum continuous

NOTE

If the battery is partially discharged, the BATTERY CHG annunciator will illuminate approximately 6 seconds after external power is on line. If the annunciator does not extinguish within 5 minutes, refer to the Battery Chg Annunciator Illuminated procedure in Chapter 9.

The battery should be on to absorb transients present in some auxiliary power units. An **EXT PWR** annunciator alerts the crew when an external power plug is connected to the aircraft.

*8-22. FIRST ENGINE START (BATTERY START).

NOTE

After turning on the BATT SWITCH, wait a full 10 seconds before starting the engines to allow the ETM to complete its setup procedures.

Starting procedures are identical for both engines except the second engine generator is kept off line after the second engine start to allow performing the current limiters check. When making a battery start, the right engine should be started first. A crewmember should monitor the outside observer throughout the engine start.

1. Propeller area – Clear.

2. Engine – Start.

a. **IGNITION AND ENGINE START** switch – **ON**. **IGN ON** annunciator should illuminate and associated **FUEL PRESS** annunciator should extinguish.

CAUTION

If ignition does not occur within 10 seconds after moving the condition lever to LOW IDLE initiate Engine Clearing procedure, Paragraph 8-25. If for any reason the starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

b. **CONDITION** lever (after N_1 stabilizes at or above 12% for 5 seconds minimum) – **LOW IDLE**.

CAUTION

Monitor ITT to avoid a hot start. If there is a rapid rise in ITT, be prepared to abort the start before limits are exceeded. During starting, the maximum allowable ITT is l000 ºC for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8-24, and discontinue start. Record the peak temperature and duration on DA Form 2408-13-1.

c. **ITT** and N_1 – Monitor. **ITT** 1000 °C maximum. N_1 minimum 61%.

d. Oil pressure – Check (60 psi minimum).

e. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT decreasing.

3. **CONDITION** lever – **HIGH IDLE**. Monitor **ITT** as the condition lever is advanced.

NOTE

Ensure N_1 is at high idle before turning on generator.

4. **GEN** switch – **RESET**, then **ON**.

5. **BATTERY CHG** annunciator – Monitor.

*8-23. SECOND ENGINE START (BATTERY START).

1. First engine generator load – 50% or less.

2. Propeller area – Clear.

3. Engine – Start.

a. **IGNITION AND ENGINE START** switch – **ON**. **IGN ON** light should illuminate and **FUEL PRESS** light should extinguish.

CAUTION

If ignition does not occur within 10 seconds after moving the condition lever to LOW IDLE, initiate Engine Clearing procedure, Paragraph 8-25. If for any reason the starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1 minute minimum).

b. **CONDITION** lever (after N_1 stabilizes at or above 12% for 5 seconds minimum) – **LOW IDLE**.

CAUTION

Monitor ITT to avoid a hot start. If there is a rapid rise in ITT, be prepared to abort the start before limits are exceeded. During starting, the maximum allowable ITT is 1000 °C for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8-24, and discontinue start. Enter the peak temperature and duration on DA Form 2408-13-1.

c. **ITT** and N_1 – Monitor. **ITT** 1000 °C maximum. N_1 minimum 61%.

d. Oil pressure – Check (60 psi minimum).

e. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT decreasing.

4. **BATTERY CHG** annunciator – Check.

5. DC volt/loadmeters – Check loads, voltage, and current limiters.

6. Second engine **GEN** switch – **RESET**, then **ON**.

7. **CONDITION** levers – As required.

8. **CABIN TEMP MODE** – Set.

9. Inverters – Check and **ON**.

10. AC/DC power – Check.

a. Frequency and volts:

(1) AC frequency 380 to 420 Hz.

(2) AC voltage – 105 to 120 Vac.

(3) DC voltage – 27.5 to 29.0 Vdc.

b. DC loads: Parallel within 10%.

(1) 75% maximum – **LOW IDLE**.

(2) 85% maximum – **HIGH IDLE**.

(3) 85% maximum – Ground Operations.

11. **AVIONICS MASTER PWR** – **ON**.
12. **STANDBY HORIZON** – **ON** and uncaged.
13. **EFIS POWER** switches – **ON**.
14. **AP/TRIM POWER** switch – **ON**.
15. Autopilot self-test – Monitor.

    a. Allow 3-4 minutes for gyros to erect, **HDG** and **ATTITUDE** flags clear.

    b. **AP FAIL** and **AP TRIM FAIL** – Annunciators illuminate upon initial application of **AP/TRIM POWER** and then extinguish (followed by an audio test tone) after successful completion of the self-test. Allow 60 seconds after gyros are valid.

    c. Repeat self-test on copilot side.

CAUTION

Taxi with caution. The autopilot temporarily engages the servos during the automatic self-test. Be prepared to overpower the autopilot as required.

NOTE

Illumination of the AP FAIL annunciator other than during initial power-up indicates a failure. This failure annunciation will result in power being removed from the roll, pitch, yaw, pitch trim, and rudder trim servos. The flight director may remain functional depending upon the nature of the failure. The continuous self-test feature may also inhibit flight director, autopilot, and electric trim use without illumination of the AP FAIL annunciator.

16. Engine instruments – Check.

8-24. ABORT START.

1. **CONDITION** lever – **FUEL CUTOFF**.
2. **IGNITION AND ENGINE START** switch – **STARTER ONLY**.
3. **ITT** – Monitor for drop in temperature.
4. **IGNITION AND ENGINE START** switch – **OFF**.

8-25. ENGINE CLEARING.

1. **CONDITION** lever – **FUEL CUTOFF**.
2. **IGNITION AND ENGINE START** switch – **OFF** (1 minute minimum).

CAUTION

Do not exceed starter limitation of 40 seconds on and 60 seconds off for two starting attempts and engine clearing procedure. Allow 30 minutes off before additional starter operation.

3. **IGNITION AND ENGINE START** switch – **STARTER ONLY** (15 seconds minimum, 40 seconds maximum).
4. **IGNITION AND ENGINE START** switch – **OFF**.

*8-26. FIRST ENGINE START (GPU START).

NOTE

After turning on the GPU, wait a full 10 seconds before starting the engines to allow the ETM to complete its setup procedures.

When making a GPU start, the left engine should be started first due to the GPU receptacle being located adjacent to the right engine. Normally, only one engine is started utilizing the GPU, reverting to a battery start procedure for the second engine start.

1. Propeller area – Clear.
2. Engine – Start.

    a. **IGNITION AND ENGINE START** switch – **ON**. **IGN ON** light illuminated and associated **FUEL PRESS** light extinguished.

CAUTION

If ignition does not occur within 10 seconds after moving the condition lever to LOW IDLE, initiate Engine Clearing procedure, Paragraph 8-25. If for any reason the starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

b. **CONDITION** lever (after N_1 stabilizes at or above 12% for 5 seconds) – **LOW IDLE**.

CAUTION

Monitor ITT to avoid a hot start. If there is a rapid rise in ITT, be prepared to abort the start before limits are exceeded. During engine start, the maximum allowable ITT is 1000 °C for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8-24, and discontinue start. Record the peak temperature and duration on DA Form 2408-13-1.

c. **ITT** and N_1 – Monitor. **ITT** 1000 °C maximum. N_1 minimum 61%.

d. Oil pressure – Check (60 psi minimum).

e. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT decreasing.

3. **CONDITION** lever – **HIGH IDLE**. Monitor **ITT** as the condition lever is advanced.

4. GPU – As required. Disconnect if second engine start is to be a battery start. Refer to Second Engine Start (Battery Start) procedure, Paragraph 8-23.

CAUTION

Do not turn on generators with GPU connected.

5. **GEN** switch (after GPU disconnected and ensure N_1 is at High Idle) – **RESET** then **ON**.

NOTE

After starting the first engine with a GPU, the second engine is normally started utilizing a battery start. If a GPU start is required or desired for the second engine start, use the Second Engine Start (GPU Start) procedure, Paragraph 8-27. Otherwise, use Second Engine Start (Battery Start) procedure, Paragraph 8-23.

6. **BATTERY CHG** annunciator – Monitor.

* 8-27. SECOND ENGINE START (GPU START).

1. Propeller area – Clear.

2. Engine – Start.

a. **IGNITION AND ENGINE START** switch – **ON**. **IGN ON** light illuminated and the associated **FUEL PRESS** light extinguished.

CAUTION

If ignition does not occur within 10 seconds after moving condition lever to low idle, initiate Engine Clearing procedure, Paragraph 8-25. If for any reason a starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

b. **CONDITION** lever (after N_1 RPM stabilizes at or above 12% for 5 seconds) – **LOW IDLE**.

CAUTION

Monitor ITT to avoid a hot start. If there is a rapid rise in ITT, be prepared to abort the start before limits are exceeded. During engine start, the maximum allowable ITT is 1000 °C for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8-24, and discontinue start. Record the peak temperature and duration on DA Form 2408-13-1.

c. **ITT** and N_1 – Monitor. **ITT** 1000 °C maximum. N_1 minimum 61%.

d. Oil pressure – Check (60 psi minimum).

e. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT decreasing.

3. Right **PROP** lever – **FEATHER**.

4. GPU – Disconnect.

5. Right **PROP** lever – **HIGH RPM** when ground personnel are clear.

6. **GEN** switches – **RESET**, then **ON**.

7. DC volt/loadmeters – Check loads, voltage, and current limiters.

8. **CONDITION** levers – As required.

9. **CABIN TEMP MODE** – Set.

10. Inverters – Check.

11. AC/DC power – Check.

a. Frequency and Volts:

(1) AC frequency - 380 Hz to 420 Hz.

(2) AC voltage – 105 Vac to 120 Vac.

(3) DC voltage – 27.5 Vdc to 29.0 Vdc.

b. DC loads (Parallel within 10%):

(1) 75% maximum – **LOW IDLE**

(2) 85% maximum – **HIGH IDLE**.

(3) 85% maximum – Ground Operations.

12. **AVIONICS MASTER PWR** – **ON**.

13. **STANDBY HORIZON** – **ON**, and uncaged.

14. **EFIS POWER** switches – **ON**.

15. **AP/TRIM POWER** switch – **ON**.

16. Autopilot self-test – Monitor.

a. Allow 3-4 minutes for gyros to erect, **HDG** and **ATTITUDE** flags clear.

b. **A/P FAIL** and **A/F TRIM FAIL** – Annunciators illuminate upon initial application of **AP/TRIM POWER** and then extinguish (followed by an audio test tone) after successful completion of the self-test. Allow 60 seconds after gyros are valid.

c. Repeat self-test on copilot's side.

CAUTION

Taxi with caution. The autopilot temporarily engages the servos during the automatic self-test. Be prepared to overpower the autopilot as required.

NOTE

Illumination of the AP FAIL annunciator other than during initial power-up indicates a failure. This failure annunciation will result in power being removed from the roll, pitch, yaw, pitch trim, and rudder trim servos. The flight director may remain functional depending upon the nature of the failure. The continuous self-test feature may also inhibit flight director, autopilot, and electric trim use without illumination of the AP FAIL annunciator.

17. Engine instruments – Check.

8-28. BEFORE TAXIING.

* 1. **CABIN** signs – As required.

* 2. **BLEED AIR VALVES** – As required.

* 3. **AFT BLOWER** – As required.

* 4. Avionics – Check and set.

* 5. EFIS – **TEST**.

★ 6. Flight controls/autopilot system – Check.

a. **AP XFER** switch – Select pilot's side.

b. **AP** mode selector button (**AP**) – Press to engage autopilot.

c. Press red **INTRP & TRIM AP DISC** button – Ensure AP disengages.

If the crew determines a more extensive test is desired, engage AP and continue with steps d through g.

WARNING

If unable to overpower the autopilot in any axis, do not use.

d. Flight controls – Overpower autopilot in pitch, roll and yaw axis.

e. Auto trim – Check.

(1) Apply nose up force on control wheel – Note nose down trim motion after approximately 3 seconds.

(2) Apply nose down force on control wheel – Note nose up trim motion after approximately 3 seconds.

(3) Press right rudder – Note left rudder trim motion after approximately 3 seconds.

(4) Press left rudder – Note right rudder trim motion after approximately 3 seconds.

(5) Select **HDG** mode – Observe **FD** commands and control wheel motion correspond to movement of the heading selector knob.

(6) **AP DISC & TRIM INTRPT** – Press and release. Note autopilot disconnection, flashing **AP** annunciation, and aural disconnect tone.

f. Manual electric trim – Check.

(1) Pilot and copilot control wheel trim switches – Check.

WARNING

Operation of the electric trim switch system should occur only by movement of pairs of switches. Any movement of the elevator trim wheel while depressing only one switch element denotes a trim system malfunction. The AP/TRIM POWER switch must be turned OFF and flight conducted only by manual operation of the trim wheel.

(2) Pilot and copilot trim switches – Check individual element for no movement of trim, then check proper operation of both elements.

(3) Pilot trim switches – Check that pilot switches override copilot switches while trimming in opposite directions, and trim moves in direction commanded by pilot.

(4) Pilot and copilot trim switches – Check trim disconnects while activating pilot or copilot trim disconnect switches.

g. **AP XFER** switch – Select copilot's side and repeat steps b through e.

* 7. FMS – Check and Set.

a. Initialize. Insert identifier for current airfield during initialization.

b. Load flight plan as required.

* 8. Voice and flight data recorders – Check.

9. Radar – As required.

* 10. Altimeters – Set and check.

11. **FLAPS** – Check.

12. EFIS brightness – Set.

CAUTION

Do not leave brake deice on longer than required to check function of annunciators when ambient temperatures are above 15 °C.

★ 13. **BRAKE DEICE** – Check, use as required.

NOTE

Brake deice control valves may become inoperative if valves are not cycled periodically. One cycle of the valves is required daily regardless of the weather conditions.

a. **BLEED AIR VALVES** – **OPEN.**

b. **BRAKE DEICE** – **ON**, annunciator illuminated.

c. **CONDITION** levers – **HIGH IDLE** if brake deice is to be used.

d. **BRAKE DEICE** – **OFF**, annunciator extinguished.

e. **CONDITION** levers – As required.

★* 14. **TCAS** – **TEST** and set.

★* 15. EGPWS – Test.

* 16. Exterior lights – As required.

* 17. Taxi area – Clear.

***8-29. TAXIING.**

CAUTION

Never taxi with a flat tire or a flat shock strut. During taxi operations, particular attention should be given to propeller tip clearance. Extreme caution is required when operating on unimproved or irregular surfaces or when high winds exist. If operations produce a propeller RPM over 1600, retard propeller levers to the detent to limit RPM to 1600 to help reduce the possibility of ingestion of ground debris.

1. Brakes – Check.

2. Flight instruments – Check.

8-30. ENGINE RUNUP.

1. Parking brake – Set.

2. Manual prop feathering – Check.

★ 3. **AUTOFEATHER/AUTO IGNITION** – Check as required.

a. **AUTO IGNITION** switches – **ARM**.

b. **POWER** levers – 22% torque. Auto ignition annunciators extinguish.

c. **AUTOFEATHER** switch – Hold to **TEST**. Both **AUTOFEATHER** annunciators illuminated.

d. **POWER** levers – Retard individually.

NOTE

AUTOFEATHER annunciators will illuminate and extinguish with each fluctuation of torque as the propeller feathers.

(1) Approximately 16 to 21% torque, opposite **AUTOFEATHER** annunciator extinguishes, **IGN ON** annunciator illuminated.

(2) Approximately 9 to 14% torque, both **AUTOFEATHER** annunciators extinguished (prop begins to feather).

(3) Return **POWER** levers to approximately 22% torque.

e. Repeat procedure with other engine.

f. **POWER** levers – **IDLE**.

g. **AUTOFEATHER** switch – **ARM**.

h. **AUTO IGNITION** switches – **OFF**.

★ 4. Overspeed governors and rudder boost – Check as required.

a. **RUDDER BOOST** switch – On.

b. **PROP** levers – **HIGH RPM**.

c. **PROP GOV TEST** switch – Hold in **TEST** position.

d. Left **POWER** lever – Increase until propeller is stabilized at 1830 – 1910 RPM. Continue to increase until rudder movement is noted. (Observe **ITT** and torque limits.)

e. **POWER** lever – Retard to **IDLE**.

f. Repeat steps c, d, and e for the right engine.

★ 5. Primary governors – Check as required.

a. **POWER** levers – Set 1800 RPM.

b. **PROP** levers – Retard to **FEATHER** detent. Note propellers stabilize between 1600 and 1640 RPM.

c. **PROP** levers – **HIGH RPM**. Note propellers return to 1800 RPM.

★ 6. **ENGINE ANTI-ICE** – Check. If already **ON**, reverse steps a and b.

a. **ENGINE ANTI-ICE** – **ON**.

(1) Both advisory lights illuminated.

(2) Both bypass doors extended.

(3) Maximum time for (1) and (2) is 15 seconds.

b. **ENGINE ANTI-ICE** – **OFF**.

(1) Both advisory lights extinguish.

(2) Both bypass doors retracted.

(3) Maximum time for (1) and (2) is 15 seconds.

c. Electrical standby system – Check.

7. **CONDITION** levers – **HIGH IDLE**.

8. **POWER** levers **– IDLE.**

★ 9. Anti-ice/deice systems – Check.

a. **PROP** deice – Check. When **MANUAL** mode is selected, note rise on DC loadmeter. When **AUTO** mode is selected, monitor prop ammeter for 90 seconds and ensure the indicator remains in the normal operating range the entire time.

NOTE

If windshield heat is needed prior to takeoff, use NORMAL setting for a minimum of 15 minutes prior to selecting HIGH to provide adequate preheating and minimize the effects of thermal shock. The windshield heat thermostat will invalidate the check in OAT above 20 to 30 °C.

b. **WSHLD ANTI-ICE** – Check. Note increases on the loadmeter and cycle through both normal and high settings.

c. All anti-ice/deice switches – **OFF**.

d. Surface deice system – Check.

★ 10. Vacuum and pneumatic system – Check.

a. **LEFT BLEED AIR VALVE** – **OFF**.

(1) Pneumatic and suction pressures remain normal.

(2) **L BL AIR OFF** annunciator illuminates.

(3) Both **BL AIR FAIL** annunciators remain extinguished.

b. **RIGHT BLEED AIR VALVE** – **OFF**.

(1) Pneumatic and suction pressures

read zero.

(2) Both **BL AIR OFF** and **BL AIR FAIL** annunciators illuminated.

c. **LEFT BLEED AIR VALVE** – **ON**.

(1) Pneumatic and suction pressures return to normal.

(2) Both **BL AIR FAIL** annunciators extinguished.

(3) **L BL AIR OFF** annunciator extinguished.

d. **RIGHT BLEED AIR VALVE** – **ON**.

(1) **R BL AIR OFF** annunciator extinguished.

★ * 11. Pressurization – Check and set.

a. **BLEED AIR VALVES** – Both **ON**.

b. **CABIN ALTITUDE** – Set 500 feet lower than field pressure altitude.

c. **CABIN PRESS** switch – **TEST**. Cabin climb/descent gauge indicates a descent.

d. **CABIN PRESS** switch – Release. Cabin climb/descent gauge indicates a climb, then stabilizes at zero climb.

e. Altitude selector – Set as required. Pressure altitude + 200 feet.

12. **CONDITION** levers – As required.

13. Radar – Check.

*8-31. BEFORE TAKEOFF.

1. Fuel panel – Check fuel quantity and switch positions.
2. **AUTOFEATHER – ARMED**.
3. Flight and engine instruments – Check.
4. Avionics – Set.
5. Altitude alerter(s) – Set and check.
6. Propellers – **HIGH RPM**.
7. **FLAPS** – As required.
8. Trim – Set.
9. Autopilot/yaw damper – **OFF**.
10. **BLEED AIR VALVES** – As required.
11. Annunciator lights – Check.
12. Flight controls – Check.

★ 13. Departure briefing – Complete.

*8-32. LINE UP.

1. Transponder / TCAS / Wx Radar / EGPWS – As required.
2. **LANDING**, **TAXI**, **RECOG**, and **STROBE** lights – **ON**.
3. Anti-ice/deice – As required.
4. **ENGINE ANTI-ICE** – As required.
5. **AUTO IGNITION** – **ARM**.
6. **CONDITION** levers – **HIGH IDLE**.
7. Power stabilized – 27% torque minimum.

8-33. TAKEOFF.

To aid in planning the takeoff and to obtain maximum aircraft performance, make full use of the information affecting takeoff shown in Chapter 7. The data shown was achieved by setting brakes, setting takeoff power, and then releasing brakes, but this method is not required. The takeoff will be accomplished in accordance with the appropriate Aircrew Training Manual (ATM). The PNF operates the PF's controls on the extended pedestal from the beginning of the takeoff roll until the After Takeoff checklist is completed or the Autopilot is engaged, whichever comes first.

8-34. AFTER TAKEOFF.

WARNING

During takeoff and climb, the pilot flying the aircraft should avoid adjusting controls located on the aft portion of the extended pedestal to preclude inducing spatial disorientation.

1. **GEAR** – **UP**.
2. **FLAPS** (105 KIAS) – **UP**.
3. Climb power – Set.
4. **LANDING**/**TAXI** lights – **OFF**.
5. Wings and nacelles – Check.

8-35. CLIMB.

a. Cruise Climb. Cruise climb is performed at a speed that is the best combination of climb, fuel burn-off, and distance covered. Set propellers at 1900 RPM and torque at maximum allowable (or maximum climb ITT, monitor N_1). Adhere to the following airspeed schedule as closely as possible.

SL to 10,000 feet.....………..………160 KIAS

10,000 to 20,000 feet……………...140 KIAS

20,000 to 25,000 feet……………...130 KIAS

25,000 to 35,000 feet.……………..120 KIAS

b. Climb – Maximum Rate. Maximum rate of climb performance is obtained by setting propellers at 2000 RPM, torque at maximum allowable (or maximum **ITT**, monitor N_1), and maintaining best rate-of-climb airspeed. Refer to Chapter 7 for best rate-of-climb airspeed (V_y) for specific weights.

c. Climb Checklist. Complete as follows:

1. **YD** – As required.
2. **AUTOFEATHER** – As required.
3. Cabin pressurization – Check. Adjust rate control knob so that cabin rate-of-climb equals one third of aircraft rate-of-climb. Recommend setting cruise altitude +1000 ft.
4. **CABIN** signs – As required.
5. **BRAKE DEICE** – As required.
6. **WSHLD ANTI-ICE** – As required.

NOTE

Turn the windshield heat on to NORMAL when passing 10,000 feet MSL or prior to entering the freezing level, whichever comes first. Leave on until no longer required during descent for landing. HIGH temperature may be selected as required after a minimum warmup period of 15 minutes.

7. Altimeters – Set.
8. **TCAS** – Set range.

8-36. CRUISE.

1. **POWER** – Set. Refer to the cruise power graphs contained in Chapter 7.

NOTE

A new engine operated at the torque value presented in the cruise power charts will show an ITT margin below the maximum cruise limit for the torque value presented in the charts. With ice vanes retracted, ENGINE ANTI-ICE OFF, if cruise torque settings shown on the power charts cannot be obtained without exceeding ITT limits, the engine should be inspected.

2. **ICE PROTECTION** switches – As required. Ensure anti-ice equipment is activated before entering icing conditions.
3. **CABIN** signs – As required.
4. **AUXILIARY** fuel gauges – Monitor. Ensure fuel is being transferred from auxiliary tanks. (Chapter 2, Section IV).
5. Altimeters – Check. Verify altimeter settings are correct.
6. Engine instruments – Check. Note indications.
7. **TCAS** – Set for enroute.

8-37. DESCENT – ARRIVAL.

Perform the following checks prior to the final descent for landing.

1. Cabin pressurization – Set. Adjust cabin controller dial as required.
2. **CABIN** signs – As required.
3. **ICE PROTECTION** switches – As required.

NOTE

Set windshield heat to NORMAL or HIGH as required well before descent into icing conditions or into warm moist air to aid in defogging. Turn off windshield heat when descent is completed to lower altitudes and when heating is no longer required. This will preclude possible windshield distortions.

4. **WSHLD ANTI-ICE** – As required.
5. **RECOG** lights – **ON**.
6. Altimeters – Set to current setting.
7. **TCAS** – Set as required.

★ 8. Arrival briefing – Complete.

8-38. DESCENT.

Descent from cruise altitude should normally be made by letting down at cruise airspeed with reduced power. Refer to Chapter 7 for power settings and rates of descent.

NOTE

Cabin pressure controller should be adjusted prior to starting descent.

a. Descent – Maximum Rate (Clean). To obtain the maximum rate of descent in clean configuration, perform the following:

1. Cabin pressurization – Set. Adjust cabin controller dial as required. While descending, adjust rate control knob so that cabin rate of descent equals one-third aircraft rate of descent.
2. **CABIN** signs – As required.
3. **POWER** levers – **IDLE**.
4. **PROP** levers – **HIGH RPM**.
5. **GEAR – UP**.
6. **FLAPS – UP**.
7. Airspeed – V_{mo} maximum.
8. **ICE PROTECTION** switches – As required.
9. **RECOG** lights – As required.
10. O Ferry fuel caps – Loosen or remove if rate of descent exceeds 1500 fpm.

b. Descent – Maximum Rate (Landing Configuration). If required to descend at a low airspeed (e.g., to conserve airspace or in turbulence), approach flaps and landing gear may be extended to increase the rate and angle of descent while maintaining a slower airspeed. To perform, use the following procedure:

1. Cabin pressurization – Set. Adjust cabin controller dial as required. While descending, adjust rate control knob so that cabin rate of descent equals one-third aircraft rate of descent.
2. **CABIN** signs – As required.
3. **POWER** levers – **IDLE**.
4. **PROP** levers – **HIGH RPM**.
5. **FLAPS – APPROACH**.
6. **GEAR – DN**.
7. Airspeed – 181 KIAS maximum.
8. **ICE PROTECTION** switches – As required.
9. **RECOG** lights – As required.
10. O Ferry fuel caps – Loosen or remove if rate of descent exceeds 1500 fpm.

8-39. APPROACH.

1. **HSI NAV SOURCE** – As required.
   a. Ensure the correct navigational source for the approach has been selected and the TA-12 deselected as GPS sensor.
2. **TCAS** – Set as required.

8-40. BEFORE LANDING.

1. **CABIN** signs – **NO SMOKE & FSB**.
2. **AUTOFEATHER** – **ARM**.
3. **ENGINE ANTI-ICE** – As required.
4. **PROP** levers – As required.

NOTE

During approach, propellers should be set at 1900 RPM to prevent glideslope interference (ILS approach), provide better power response during approach, and minimize attitude change when advancing propeller levers for landing.

5. **FLAPS** (below 200 KIAS) – **APPROACH**.
6. **GEAR** (below 181 KIAS) – **DOWN**/confirm.
7. **LANDING/TAXI LIGHTS** – As required.
8. **BRAKE DEICE** – As required.
9. **CONDITION** levers – **HIGH IDLE**.
10. **TCAS** – Set as required.
11. EGPWS – Set as required. Select Terrain Inhibit (**TERR INHBT**) for runways shorter than 3,500 feet and/or non-hard-surfaced.

8-41. LANDING.

Performance data charts for landing computations assume the runway is paved, level, and dry. Additional runway must be allowed when these conditions are not met. Do not consider headwind during landing computations. However, if landing must be downwind, include the tailwind in landing distance computation. Conduct all landings in accordance with the Aircrew Training Manual (ATM). Perform the following procedure as the aircraft nears the runway.

1. **AP & YD** – Disengaged.
2. Gear down lights – Check/confirm.
3. **PROP** levers – **HIGH RPM**.

8-42. TOUCH AND GO LANDING.

The instructor must select a point on the runway where all pre-takeoff procedures will have been completed prior to the pilot's initial application of power. In selecting this point, prime consideration shall be given to the required accelerate-stop distance pre-computed on a current TOLD Card. The nose wheel should be on the runway and rolling straight before the power is advanced. After the pilot applies power to within 5% of the takeoff power, the instructor's actions are the same as during a normal takeoff. Use the following procedure:

1. **PROP** levers – **HIGH RPM**.
2. **FLAPS** – As required.
3. Trim – Set.
4. Power stabilized – Check 27% torque minimum.
5. Takeoff power – Set.

8-43. GO AROUND/MISSED APPROACH.

Accomplish the maneuver in accordance with the ATM utilizing the following procedure:

1. **POWER** – As required.
2. **FLAPS –** Retract to **APPROACH.**
3. **GEAR** (Positive climb) – **UP**.
4. **FLAPS** (105 KIAS) – **UP**.
5. **LANDING/TAXI LIGHTS** – **OFF**.
6. Climb power – Set.
7. **YD** – As required.
8. **BRAKE DEICE** – **OFF**.

8-44. AFTER LANDING.

Complete the following procedures after the landing rollout is complete and normal taxi speed is attained:

1. Radar/transponder – **STBY**.
2. **CONDITION** levers – As required.
3. **FLAPS** – **UP**.
4. **AUTO IGNITION** – **OFF**.
5. **AUTOFEATHER** – **OFF**.
6. **ENGINE ANTI-ICE** – As required.
7. **ICE PROTECTION** switches – As required.
8. **LANDING/TAXI LIGHTS** – As required.
9. **STROBE** lights – **OFF**.
10. **RECOG** lights – **OFF**.
11. Trim – Set.

8-45. ENGINE SHUTDOWN.

NOTE

To prevent sustained loads on rudder shock links, the aircraft should be parked with the nose gear centered.

1. Parking brake – Set.
2. **EFIS POWER** switches – **OFF**.
3. **AP/TRIM POWER** switch – **OFF**.
4. Avionics – As required.
5. **STANDBY HORIZON** – Caged and **OFF**.
6. **INVERTER** – **OFF**.
7. **CABIN TEMP MODE** – **OFF**.
8. **BLEED AIR VALVES** – **ENVIR OFF**.
9. **VENT BLOWER** – **AUTO**.
10. **AFT BLOWER** – **OFF**.
11. **LANDING/TAXI LIGHTS** – **OFF**.
12. **ICE PROTECTION** switches – **OFF.**
13. Battery condition – Check. Battery charge light should be extinguished. If it is illuminated, turn the battery switch **OFF** momentarily and note loadmeter reading.

Turn the battery switch **ON** and wait approximately 90 seconds, then turn the battery switch **OFF** and note loadmeter reading. Battery condition is unsatisfactory if the battery charge light remains illuminated and charge current fails to decrease between checks.

CAUTION

Monitor ITT during shutdown. If sustained combustion is observed, proceed immediately to Abort Start procedure, Paragraph 8-24.

14. **ITT** – Check. Must be 750° or below for 1 minute prior to shutdown.
15. **CONDITION** levers – **FUEL CUTOFF**.
16. **PROP** levers – **FEATHER**.

WARNING

Do not turn off exterior lights until propeller rotation has stopped.

17. Exterior lights – **OFF**.
18. DC voltmeters – Check voltage.
19. Overhead panel switches – As required.
20. Oxygen system – Off.
21. **AVIONICS MASTER PWR** – **OFF**.

NOTE

Wait until the gas generator speed of both engines drops below 10% prior to turning off the MASTER SWITCH.

22. **MASTER SWITCH** – **OFF**.
23. Chocks – As required.
24. Parking brake – As required.
25. Control locks – As required.

8-46. BEFORE LEAVING AIRCRAFT.

1. Wheels – Chocked.

NOTE

Brakes should be released after chocks are in place (ramp conditions permitting).

2. Parking brake – As required.
3. Flight controls – Locked.
4. Overhead flood lights – **OFF**.
5. **STANDBY PUMPS** – **OFF**.
6. Transponder – As required.
7. COMSEC – Zeroize as required.
8. Emergency exit lock – As required.
9. Aft cabin light – **OFF**.
10. Door light – **OFF**.

CAUTION

If strong winds are anticipated while the aircraft is unattended, the propellers shall be secured to prevent windmilling with zero engine oil pressure.

11. Walk-around inspection – Complete. Conduct a thorough walk-around inspection, checking for damage, fluid leaks, and levels. Check that covers, tiedowns, restraints, and chocks are installed as required.
12. Aircraft forms – Complete. In addition to established requirements for reporting any system defects, or unusual and excessive operation such as hard landings, etc., the flight crew will also make entries on DA Form 2408-13-1 to indicate when limits in the Operator's Manual nave been exceeded.
13. Aircraft secured – Check. Lock cabin door as required.

Section III. INSTRUMENT FLIGHT

8-47. GENERAL.

This aircraft is qualified for operation in instrument flight meteorological conditions. Flight handling, stability characteristics, and range are the same during instrument flight conditions as when under visual flight conditions.

8-48. INSTRUMENT FLIGHT PROCEDURES.

Refer to FM 1-240, FM 1-230, FLIP, AR 95-1, TC 1-218, FAR 91 (subparts A and B), applicable foreign government regulations, and procedures described in this manual. Accomplish all instrument flight tasks in accordance with the appropriate ATM.

Section IV. FLIGHT CHARACTERISTICS

8-49. STALLS.

A pre-stall warning in the form of very light buffeting can be felt when a stall is approached. A mechanical warning is also provided by a warning horn. The warning horn starts to alarm approximately 5 to 10 knots above stall speed with the aircraft in any configuration. If correct stall recovery technique is used, little altitude will be lost during the stall recovery. For the purpose of this section, the term "power-on" means that both engines and propellers are operating normally and are responsive to pilot control. The term "power-off" means that both engines are operating at idle power. Landing gear position has no effect on stall speed. During practice, enter power-off stalls from normal glides. Enter power-on stalls by smoothly increasing pitch attitude to a climb attitude (do not exceed 20°), and hold that attitude until the stall occurs.

a. Power-On Stalls. The power on stall attitude is steep and, unless this high pitch attitude is maintained, the aircraft will generally "settle" or "mush" instead of stall. It is difficult to stall the aircraft inadvertently in any normal maneuver. A light buffet precedes most stalls, and the first indication of approaching stall is generally a decrease in control effectiveness, accompanied by a stall warning horn. The stall itself is characterized by a rolling tendency if the aircraft is allowed to yaw. The proper use of rudder will minimize the tendency to roll. A slight pitching tendency will develop if the aircraft is held in the stall, resulting in the nose dropping sharply, then pitching up toward the horizon; this cycle is repeated until recovery is made. Control is regained very quickly with little altitude loss, providing the nose is not lowered excessively. Begin recovery with forward movement of the control wheel and a gradual return to level flight. The roll tendency caused by yaw is more pronounced in power-on stalls, as is the pitching tendency. However, both are easily controlled after the initial entry. Power-on stall characteristics are not greatly affected by flap position, except that stalling speed is reduced in proportion to flap extension.

b. Power-Off Stalls. The roll tendency is considerably less pronounced in power-off stalls (in any configuration), and is more easily prevented or corrected by adequate rudder and aileron control, respectively. The nose will generally drop straight through with some tendency to pitch up again if recovery is not made immediately. With flaps down, there is little or no roll tendency and stalling speed is much slower than with flaps up. The Stall Speeds chart shows the indicated power-off stall speeds with aircraft in various configurations. Refer to Figure 8-3. Altitude loss during a full stall may be as much as 1,000 feet.

c. Accelerated Stalls*.* The aircraft gives noticeable stall warning in the form of buffeting before the stall occurs. The stall warning and buffet can be demonstrated in turns by applying excessive back pressure on the control wheel.

8-50. SPINS.

Intentional spins are prohibited. If a spin is inadvertently entered, use the following recovery procedure. The first three actions should be performed as simultaneously as possible:

NOTE

Spin demonstrations have not been conducted. The recovery technique is based on the best available information.

1. **POWER** levers – **IDLE**.

2. Apply full rudder opposite direction of spin rotation.

3. Simultaneously with rudder application, push the control wheel forward and neutralize ailerons.

4. When rotation stops, neutralize rudder.

CAUTION

Do not pull out of the resulting dive too abruptly. This could cause excessive wing loads and possibly a secondary stall.

5. Pull out of dive by exerting a smooth, steady back pressure on control wheel, avoiding an accelerated stall and excessive aircraft stresses.

8-51. DIVING.

Maximum airspeed (red line) V_{mo}/M_{mo} is 259 KIAS or .52 Mach. Flight characteristics are conventional throughout a dive maneuver. However, caution should be used if rough air is encountered after maximum allowable dive speed has been reached. Dive recovery should be very gentle to avoid excessive aircraft stresses.

8-52. MANEUVERING FLIGHT.

Maneuvering speed (V_a) at which full abrupt control inputs can be applied without exceeding the design load factor of the aircraft is shown in Chapter 5. The data is based on 12,500 pounds and there are no restrictions below this weight. There are no unusual characteristics during accelerated flight.

STALL SPEEDS-POWER IDLE

NOTES:

1. MAXIMUM ALTITUDE LOSS DURING A NORMAL STALL RECOVERY IS APPROXIMATELY 1000 FEET.
2. MAXIMUM NOSE DOWN PITCH ATTITUDE AND ALTITUDE LOSS DURING RECOVERY FROM ONE ENGINE INOPERATIVE STALLS PER FAR 23.205 ARE APPROXIMATELY 20° AND 850 FEET RESPECTIVELY.
3. A NORMAL STALL RECOVERY TECHNIQUE MAY BE USED. THE BEST PROCEDURE IS A BRISK FORWARD WHEEL MOVEMENT TO A NOSE DOWN ATTITUDE. LEVEL THE AIRPLANE AFTER AIRSPEED HAS INCREASED APPROXIMATELY 25 KNOTS ABOVE STALL.

EXAMPLE:

WEIGHT .... 11,700 LBS
FLAPS .... APPROACH
ANGLE OF BANK .... 30°

STALL SPEED .... 95 KTS CAS
90 KTS IAS

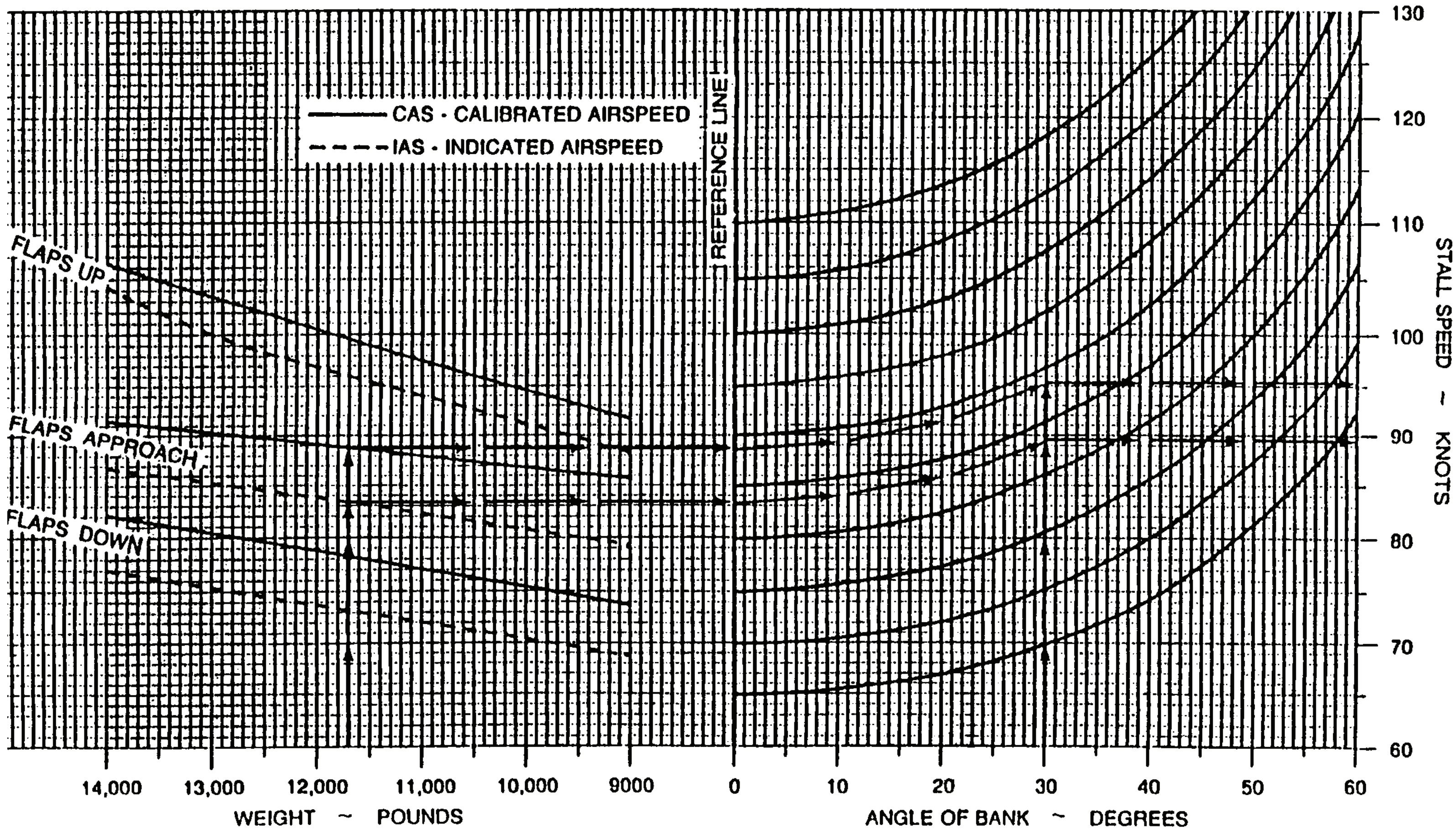


Figure 8-3. Stall Speeds – Power Idle

8-53. FLIGHT CONTROLS.

The aircraft is stable under all normal flight conditions. Aileron, elevator, rudder, and trim tab controls function effectively throughout all normal flight conditions. Elevator control forces are relatively light in the extreme aft Center of Gravity (CG) condition, progressing to moderately high with CG at the forward limit. Extending and retracting the landing gear causes only slight changes in control pressure. Control pressures resulting from changing power settings or repositioning the flaps are not excessive in the landing configuration at the most forward CG. The minimum speed at which the aircraft can be fully trimmed is 92 KIAS (gear and flaps down, propellers at high RPM). Control forces produced by changes in speed, power setting, flap position and landing gear position are light and can be overcome with one hand on the control wheel. Trim tabs permit the pilot to reduce control forces to zero. During single-engine operation, the rudder boost system aids in relieving the relatively high rudder pressures resulting from the large asymmetry in power.

8-54. LEVEL FLIGHT CHARACTERISTICS.

All flight characteristics are conventional throughout the level flight speed range.

Section V. ADVERSE ENVIRONMENTAL CONDITIONS

8-55. INTRODUCTION.

The purpose of this section is to inform the pilot of the special precautions and procedures to be followed during the various weather conditions that may be encountered in flight. This section is primarily narrative; only those checklists that cover specific procedures characteristic of weather operations are included. The checklist in Section II provides for adverse environmental operations.

8-56. COLD WEATHER OPERATIONS.

Operational difficulties may be encountered during extremely cold weather, unless proper steps are taken prior to or immediately after flight. All personnel should understand and be fully aware of the necessary procedures and precautions involved.

CAUTION

For ground operations conducive to ice accumulation on landing gear structure, use undiluted defrosting fluid on brakes and tires to reduce the tendency of ice accumulation during taxi, takeoff and subsequent landing.

a. Preparation for Flight. Accumulations of snow, ice, or frost on aircraft surfaces will adversely affect takeoff distance, climb performance, and stall speed to a dangerous degree. Such accumulations must be removed before flight. In addition to the normal exterior checks, following the removal of ice, snow, or frost, inspect wing and empennage surfaces to verify that these surfaces remain sufficiently cleared. Also, move all control surfaces to confirm full freedom of movement. Assure that tires are not frozen to wheel chocks or to the ground. Use ground heaters, anti-ice solution, or brake deice to free frozen tires. When heat is applied to release tires, the temperature should not exceed 71 °C (160 °F). Refer to Chapter 2 for anti-icing, deicing, and defrosting treatment.

b. Engine Starting. When starting engines on ramps covered with ice, propeller levers should be in the **FEATHER** position to prevent the tires from sliding. To prevent exceeding torque limits when advancing condition levers to **HIGH IDLE** during the starting procedure, place the power lever in **BETA** and the propeller lever in **HIGH RPM** before advancing the condition lever to **HIGH IDLE**.

c. Before Taxi and Engine Runup. Procedures are the same as those outlined in Section II. When the engine runup areas are slippery, the crew may not be able to safely accomplish the runup procedures without causing the aircraft to begin sliding. Under those conditions, the PC must use his judgement to determine which runup procedures will be accomplished.

d. Taxiing. Whenever possible, taxiing in deep snow, lightweight dry snow, or slush should be avoided, particularly in colder OAT conditions. If it is necessary to taxi through snow or slush, do not set the parking brake when stopped. If possible, do not park the aircraft in snow or slush deep enough to reach the brake assemblies. Chocks or sandbags should be used to prevent the aircraft from rolling while parked. Before attempting to taxi, activate the brake deice system, insuring that the bleed air valves are open and that the condition levers are in **HIGH IDLE**. An outside observer should visually check wheel rotation to ensure brake assemblies have been deiced. The condition levers may be returned to **LOW IDLE** as soon as the brakes are free of ice.

e. Before Takeoff.

CAUTION

If the possibility of ice accumulation on the horizontal stabilizer or elevator exists, do not attempt takeoff.

If icing conditions are expected, activate all anti-ice systems before takeoff, allowing sufficient time for the equipment to become effective.

f. Takeoff.

NOTE

Following takeoff from runways covered with snow or slush, consideration should be given to operating the landing gear through several complete cycles (within limits) to dislodge ice accumulated from the spray of slush and water and to prevent gear freezing in the retracted position.

Takeoff procedures for cold weather operations are the same as for normal takeoff. Taking off with temperature at or below freezing, with water, slush, or snow on the runway, can cause ice to accumulate on the landing gear and can throw ice into the wheel well areas. Such takeoffs shall be made with brake deice on and with the ice vanes extended to preclude the possibility of ice build-up on engine air inlets. Monitor oil temperature to ensure operation within limits. Before flight into icing conditions, the pilot's and copilot's **WSHLD ANTI-ICE** switches should be set at **NORMAL** position.

g. During Flight.

(1) After takeoff from a runway covered with snow or slush, it may be advisable to leave brake deice on to dislodge ice accumulated from the spray of slush or water. Monitor **BRAKE DEICE ON** annunciator for automatic termination of system operation and then turn the switch off. During flight, trim tabs and controls should also be exercised periodically to prevent freezing. Ensure that anti-icing systems are activated before entering icing conditions. Do not activate the surface deice system until ice has accumulated to 1/2 inch. The propeller deice system operates effectively as an anti-ice system and it may be operated continuously in flight. If propeller imbalance due to ice does occur, it may be relieved by increasing RPM briefly, then returning to desired setting.

(2) Ice vanes must be extended when operating in visible moisture or when freedom from visible moisture cannot be assured, at +5 °C OAT or less. Ice vanes are designed as an anti-ice system, not a deice system. After the engine air inlet screens are blocked, extending the ice vanes will not rectify the condition. Ice vanes should be retracted at +15 °C OAT and above to assure adequate engine oil cooling.

(3) Stalling airspeeds should be expected to increase when ice has accumulated on the aircraft causing distortion of the wing airfoil. For the same reason, stall warning devices are not accurate and should not be relied upon. Keep a comfortable margin of airspeed above the normal stall airspeed. Maintain a minimum of 140 knots during sustained icing conditions to prevent ice accumulation on unprotected surfaces of the wing. In the event of windshield icing, reduce airspeed to 226 knots or below.

h. Descent. Use normal procedures in Section II. Brake deicing should be considered if moisture was encountered during previous ground operations or in flight, in icing conditions with gear extended.

i. Landing. Landing on an icy runway should be attempted only when absolutely necessary and should not be attempted unless the wind is within 10° of runway heading. Application of brakes without skidding the tires on ice is difficult. In order not to impair pilot visibility, reverse thrust should be used with caution when landing on a runway covered with snow or standing water. Use procedures in Section II for normal landing.

j. Engine Shutdown. Use normal procedures in Section II.

k. Before Leaving Aircraft. When the aircraft is parked outside on ice or in a fluctuating freeze-thaw temperature condition, the following procedures should be followed in addition to the normal procedures in Section II. After wheel chocks are in place, release the brakes to prevent freezing. Fill fuel tanks to minimize condensation, remove any accumulation of dirt and ice from the landing gear shock struts, and install protective covers to guard against possible collection of snow and ice.

8-57. DESERT OPERATION AND HOT WEATHER OPERATION.

Dust, sand, and high temperatures encountered during desert operation can sharply reduce the operational life of the aircraft and its equipment. The abrasive qualities of dust and sand upon turbine blades and other moving parts of the aircraft and the destructive effect of heat upon the aircraft instruments will necessitate hours of maintenance if basic preventive measures are not followed. In flight, the hazards of dust and sand will be difficult to escape, since dust clouds over a desert may be found at altitudes up to 10,000 feet. During hot weather operations, the principal difficulties encountered are high turbine gas temperatures (ITT) during engine starting, overheating of brakes, and longer takeoff and landing rolls due to the higher density altitudes. In areas where high humidity is encountered, electrical equipment (such as communication equipment and instruments) will be subject to malfunction by corrosion, fungi, and moisture absorption by nonmetallic materials.

a. Preparation for Flight. Check the position of the aircraft in relation to other aircraft. Propeller sand blast can damage closely parked aircraft. Check that the landing gear shock struts are free of dust and sand. Check the instrument panel and general interior for dust and sand accumulation. Open main entrance door and cockpit vent storm windows to ventilate the aircraft.

CAUTION

N_1 speeds of 70% or higher may be required to keep oil temperatures within limits.

b. Engine Starting. Use normal procedures in Section II. Engine starting under conditions of high ambient temperatures may produce a higher than normal **ITT** during the start. The **ITT** should be closely monitored when the condition lever is moved to the **LOW IDLE** position. If overtemperature tendencies are encountered, the condition lever should be moved to **IDLE CUTOFF** position periodically during acceleration of gas generator **RPM (N_1).** Be prepared to abort the start before temperature limitations are exceeded.

c. Before Taxiing and engine Run Up. Use normal procedures in Section II. To minimize the possibility of damage to the engines during dusty/sandy conditions, activate ice vanes. If the temperature is above +15 °C, monitor engine oil temperatures closely.

d. Taxiing. Use normal procedures in Section II. When practical, avoid taxiing over sandy terrain to minimize propeller damage and engine deterioration that results from impingement of sand and gravel. During hot weather operation, use minimum braking action to prevent brake overheating.

e. Takeoff. Use normal procedures in Section II. Avoid taking off in the wake of another aircraft if the runway surface is sandy or dusty.

f. During Flight. Use normal procedures in Section II.

g. Descent. Use normal procedures in Section II.

h. Landing. Use normal procedures in Section II.

i. Engine Shutdown. Use normal procedures in Section II.

CAUTION

During hot weather, if fuel tanks are completely filled, fuel expansion may cause overflow, thereby creating a fire hazard.

j. Before Leaving Aircraft. Use normal procedures in Section II. Take extreme care to prevent sand or dust from entering the fuel and oil system during servicing. During hot weather, release the brakes immediately after installing wheel chocks to prevent brake disc warpage.

8-58. TURBULENCE AND THUNDERSTORM OPERATION.

CAUTION

Control in severe turbulence and thunderstorms is critical. Since turbulence imposes heavy loads on the aircraft structure, make all necessary changes in aircraft attitude with the least amount of control pressures to avoid excessive loads on the aircraft structure.

Thunderstorms and areas of severe turbulence must be avoided. If such areas are to be penetrated, it will be necessary to counter rapid changes in attitude and accept major indicated altitude variations. Penetration should be at an altitude that provides adequate maneuvering margins as a loss or gain of several thousand feet of altitude may be expected. The recommended penetration speed in severe turbulence is 170 KIAS. Pitch attitude and constant power settings are vital to proper flight technique. Establish recommended penetration speed and proper attitude prior to entering turbulent air to minimize most difficulties. False indications by the pressure instruments due to barometric pressure variations within the storm make the instruments unreliable. Maintaining a pre-established attitude will result in a fairly constant airspeed. Turn cockpit and cabin lights on to minimize the blinding effects of lightning. Do not use autopilot altitude hold. Maintain constant power settings and pitch attitude regardless of airspeed or altitude indications. Concentrate on maintaining a level attitude by reference to the flight director/attitude indicator. Maintain original heading. Make no turns unless absolutely necessary.

8-59. ICE AND RAIN (TYPICAL).

WARNING

While in icing conditions, if there is an unexplained 30% increase of torque needed to maintain airspeed in level flight, a cumulative total of 2 or more inches of ice accumulation on the wing, an unexplained decrease of 15 KIAS, or an unexplained deviation between pilot's and copilot's airspeed indicators, the icing environment should be exited as soon as practicable. Ice accumulation on the pitot tube assemblies could cause a complete loss of airspeed indication.

The following conditions indicate a possible accumulation of ice on the pitot tube assemblies and unprotected aircraft surfaces. If any of the following conditions are observed, the icing environment should be exited as soon as practicable:

1. Total ice accumulation of 2 inches or more on the wing surfaces. Determination of ice thickness can be accomplished by summing the estimated ice thickness on the wing prior to each pneumatic boot deice cycle (e.g., four cycles of minimum recommended 1/2 inch accumulation).

2. A 30% increase in torque per engine required to maintain desired airspeed in level flight (not to exceed 85% torque) when operating at recommended holding/loiter speed.

3. A decrease in indicated airspeed of 15 knots after entering the icing condition (not slower than 1.4 times the power off stall speed) if maintaining original power setting in level flight. This can be determined by comparing pre-icing condition entry speed to the indicated speed after a surface deice cycle is completed.

4. Any variations from normal indicated airspeed between the pilot's and copilot's airspeed indicators.

a. Typical Icing. Icing occurs because of supercooled water vapor such as fog, clouds, or rain. The most severe icing occurs on aircraft surfaces in visible moisture or precipitation with a true outside air temperature between –5 °C and +1 °C. However, under some circumstances, dangerous icing conditions may be encountered with temperatures below –10 °C. The surface of the aircraft must be at a temperature of freezing or below for ice to stick. If severe icing conditions are encountered, ascend or descend to altitudes where these conditions do not prevail. If flight into icing conditions is unavoidable, proper use of aircraft anti-icing and deicing systems may minimize the problems encountered. Approximately 15 minutes prior to flight into temperature conditions which could produce frost or icing conditions, the pilot and copilot windshield anti-ice switches should be set at **NORMAL** or **HIGH** temperature position (after preheating) as necessary to eliminate windshield ice. Stalling airspeeds should be expected to increase when ice has accumulated on the aircraft causing distortion of the wing airfoil. For the same reason, stall warning devices are not accurate and should not be relied upon. Keep a comfortable margin of airspeed above the normal stall airspeed with ice on the aircraft. Maintain a minimum of 140 knots during sustained icing conditions to prevent ice accumulation on unprotected surfaces of the wing. In the event of windshield icing, reduce airspeed to 226 knots or below.

b. Rain. Rain presents no particular problems other than slippery runways, restricted visibility, and occasional incorrect airspeed indications.

c. Taxiing. Extreme care must be exercised when taxiing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

d. Takeoff. Extreme care must be exercised during takeoff from ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

e. Climb. Keep aircraft attitude as flat as possible and climb with higher airspeed than usual, so that the lower surfaces of the aircraft will not be iced by flight at a high angle of attack.

f. Cruise Flight. Prevention of ice formation is far more effective and satisfactory than attempts to dislodge the ice after it has formed. If icing conditions are inadvertently encountered, turn on the anti-icing systems prior to the first sign of ice formation. Do not operate deicer boots continuously. Allow at least 1/2 inch of ice on the wing deicer boots before activating the deicer boots. Continued flight in severe icing conditions should not be attempted. If ice forms on the wing area aft of the deicer boots, climb or descend to an altitude where conditions are less severe.

g. Landing. Extreme care must be exercised when landing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid. Ice accumulation on the aircraft will result in higher stalling airspeeds due to the change in aerodynamic characteristics and increased weight of the aircraft due to ice buildup. Approach and landing airspeeds must be increased accordingly.

8-60. ICING (SEVERE).

a. The following weather conditions may be conducive to severe in-flight icing:

1. Visible rain at temperatures below 0 °C ambient air temperature.

2. Droplets that splash or splatter on impact at temperatures below 0 °C ambient air temperature.

b. The following procedures for exiting a severe icing environment are applicable to all flight phases from takeoff to landing:

1. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as –18 °C, increased vigilance is warranted at temperatures around freezing with visible moisture present.

2. Upon observing the visual cues specified in the limitations section of this manual for the identification of severe icing conditions, Paragraph 5-35, accomplish the following:

   a. Immediately request priority handling from air traffic control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the aircraft has been certified.

   b. Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.

   c. Do not engage the autopilot.

   d. If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.

   e. If an unusual roll response or uncommanded roll control movement is observed reduce the angle-of-attack.

   f. Do not extend flaps during extended operation in icing conditions. Operations with flaps extended can result in a reduced angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.

   g. If the flaps are extended, do not retract them until the airframe is clear of ice.

   h. Report these weather conditions to air traffic control.

Section VI. CREW DUTIES.

★ 8-61. CREW/PASSENGER BRIEFING.

The following guide should be used in accomplishing the required passenger briefings. Items that do not pertain to a specific mission may be omitted.

1. Crew Introduction.

2. Equipment.

   a. Personnel to include ID tags.

   b. Professional (medical equipment, etc.).

   c. Survival.

3. Flight Data.

   a. Route.

   b. Altitude.

   c. Time en route.

   d. Weather.

4. Normal Procedures.

   a. Entry and exit of aircraft.

b. Seating and seat position.

c. Seat belts.

d. Movement in aircraft.

e. Internal communications.

f. Security of equipment.

g. Smoking.

h. Oxygen.

i. Refueling.

j. Weapons and prohibited items.

k. Protective masks.

l. Toilet.

5. Emergency Procedures.

a. Emergency exits.

b. Emergency equipment.

c. Emergency landing / ditching procedures.

★ 8-62. DEPARTURE BRIEFING.

The following is a guide that should be used as applicable in accomplishing the required crew briefing prior to takeoff. However, if the crew has operated together previously (through flight) and the pilot is certain that the copilot understands all items of the briefing, the pilot may omit the briefing by stating, "Standard briefing" when the briefing is called for during the Before Takeoff Check.

1. ATC clearance – Review.

a. Routing.

b. Initial altitude.

2. Departure Procedure (DP) – Review.

a. Named Departure Procedure.

b. Obstacle Clearance Departure Procedure /Noise Abatement Procedure.

c. VFR departure route.

3. Copilot duties – Review.

a. Adjust takeoff power.

b. Monitor engine instruments.

c. Power check at 65 knots.

d. Call out engine malfunctions.

e. Tune/identify all nav/comm radios.

f. Make all radio calls.

g. Adjust transponder and radar as required.

h. Complete flight log during flight (note altitudes and headings).

i. Note departure time.

j. Retract gear and flaps – As directed.

4. TOLD card – Review.

a. Takeoff power.

b. V_1/V_r.

c. V_2 + 10 KIAS (climb to 1500 feet AGL).

d. V_2/V_{yse}.

★ 8-63. ARRIVAL BRIEFING.

The following is a guide that should be used as applicable in accomplishing the required crew briefing prior to landing. However, if the crew has operated together previously (through flight) and the pilot is certain that the copilot understands all items of the briefing, the pilot may omit the briefing by stating, "Standard briefing" when the briefing is called for during the Descent-Arrival Check:

1. Weather/altimeter setting.

2. Airfield/facilities – Review.

a. Field elevation.

b. Runway length.

c. Runway condition.

3. Approach procedure – Review.
   a. Approach plan/profile.
   b. Altitude restrictions.
   c. Missed approach.
      (1) Point.
      (2) Time.
      (3) Intentions.
   d. Decision height or MDA.
   e. Lost communications.
4. Backup approach/frequencies.
5. Copilot duties – Review.
   a. Nav/comm set-up.
   b. Monitor altitude and airspeeds.
   c. Monitor approach.
   d. Call out visual/field in sight.
6. Landing performance data – Review.
   a. Approach speed.
   b. Runway required.
7. Passenger briefing – As required.

CHAPTER 8A
NORMAL PROCEDURES T3 F3

Section I. MISSION PLANNING

8A-1. MISSION PLANNING.

Mission planning begins when the mission is assigned and extends to the preflight check of the aircraft. It includes, but is not limited to, checks of operating limits and restrictions; weight/balance and loading; performance; publications; flight plan; and crew/passenger briefings.

8A-2. OPERATING LIMITS AND RESTRICTIONS.

The minimum, maximum, normal, and cautionary operational ranges represent careful aerodynamic and structural calculations, substantiated by flight test data. These limitations must be adhered to during all phases of the mission. Refer to Chapter 5, Operating Limits And Restrictions, for detailed information.

8A-3. WEIGHT/BALANCE AND LOADING.

The aircraft must be loaded, cargo and passengers secured, and weight and balance verified per Chapter 6, Weight/Balance, And Loading.

8A-4. PERFORMANCE.

Refer to Chapter 7, Performance Data, to determine the capability of the aircraft for the entire mission. Consideration must be given to changes in performance resulting from variation in loads, temperatures, and pressure altitudes.

8A-5. FLIGHT PLAN.

A flight plan must be completed and filed per AR 95-1, DoD FLIP, and local regulations.

8A-6. CREW AND PASSENGER BRIEFINGS.

A crew/passenger briefing must be conducted for a thorough understanding of individual and team responsibilities. The briefing should include, but not be limited to, copilot and ground crew responsibilities and the coordination necessary to complete the mission most efficiently. A review of visual signals is desirable when ground guides do not have a direct voice communications link with the crew. Refer to Section VI for crew and passenger briefings.

Section II. OPERATING PROCEDURES AND MANEUVERS

8A-7. OPERATING PROCEDURES AND MANEUVERS.

This section deals with normal procedures and includes all steps necessary for safe and efficient operation of the aircraft from the time a preflight begins until the flight is completed and the aircraft is parked and secured. Unique feel, characteristics, and reaction of the aircraft during various phases of operation and the techniques and procedures used for taxiing, takeoff, climb, etc., are described, including precautions to be observed. Only the duties of the minimum crew necessary for the actual operation of the aircraft are included.

8A-8. ADDITIONAL DATA.

Procedures specifically related to instrument flight that are different from normal procedures are covered in this section following normal procedures. Descriptions of functions, operations, and effects of controls are covered in Section IV, Flight Characteristics, and are repeated in this section only when required for emphasis. Checks that must be made under adverse environmental conditions, such as desert and cold weather operations, supplement normal procedures checks in this section and are covered in Section V, Adverse Environmental Conditions. Additional crew duties are covered as necessary in Section VI, Crew Duties.

8A-9. CHECKLIST.

Normal procedures are given primarily in checklist form and are amplified as necessary in accompanying paragraph form when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operator's and Crewmember's Checklist, TM 1-1510-225-CL. To provide for easier cross referencing, the procedural steps in the checklist are numbered to coincide with the correspondingly numbered steps in this manual.

8A-10. USE OF CHECKLIST.

Although a good working knowledge of all aircraft procedures is desirable, it is not mandatory that they be committed to memory. The pilot is responsible for the initiation and accomplishment of all required checks. Checklist items will be called out orally and the action verified using the checklist (-CL). Normally, the pilot not flying (PNF) will call out the checklist, both challenge and response, and perform such duties as directed by the pilot flying (PF). "As required" will not be used as a response; instead the actual position or setting of the unit or item, such as "On" or "Up" or "Approach" will be stated. Upon completion of each checklist, the crewmember reading the checklist will announce "Checklist complete."

8A-11. CHECKS.

a. Listed below are the symbols used in the following procedures and their associated meanings.

N — Indicates performance of step is mandatory for night flights.

I — Indicates a mandatory check for instrument flights.

O — Indicates if installed.

★ — Indicates an operational check contained in the performance section of the condensed checklist.

* — Indicates performance of step is mandatory for all through flights. The asterisk applies only to checks performed prior to takeoff.

b. Placarded items such as switch and control positions appear in boldface capital letters.

8A-12. BEFORE EXTERIOR CHECK.

* 1. Forms/Publications – Check DA Forms 2408 -12, -13 series, -14, and -18, DD Form 365-4, locally required forms and publications, and availability of operator's manual (-10) and checklist (-CL).

★ 2. Oxygen system – Check. Refer to Table 8A-1.

a. Passenger manual o'ride – Push off.

b. Oxygen system ready knob – Pull ON.

c. Crew masks – **100%**; check operation and stow.

NOTE

1850 psi at 15° is a fully charged bottle. Read duration directly from Table 8A-1.

(1) Read oxygen pressure from the gauge.

(2) Read the OAT.

(3) Determine the percent of usable capacity from Figure 8A-1 (e.g., 1100 psi at 0°C = 57%).

(4) Compute the oxygen duration in minutes from Table 8A-1 by multiplying the full bottle duration by the percent of usable capacity, as in the following example:

NOTE

For oxygen duration computations, count each diluter-demand crew mask in use as two (e.g., with four passengers and a crew of two, enter the table at eight people using).

(a) Pilot and copilot with masks set at **100%** plus 6 passengers = 10 people using oxygen.

(b) Cylinder volume =115 cubic feet.

(c) Duration with full bottle = 73 minutes.

(d) Duration with 0.57% capacity: 0.57 x 73 = 41 minutes.

* 3. Flight controls – Unlock/check.

* 4. Parking brake – As required.

5. Manual trim – Check and set to zero.

* 6. **LDG GEAR CONTROL** – **DN**.

a. Manual gear extension handle – Down and latched.

O * 7. **EFIS POWER – OFF**.

★ 8. Fuel pumps/crossfeed operation – Check.

a. Fuel **FIREWALL SHUTOFF VALVES – CLOSED**.

b. **STANDBY PUMPS – ON**.

c. **BATT** switch – **ON**

d. **L** and **R FUEL PRESS** annunciators – Illuminated.

Table 8A-1. Oxygen Duration

OXYGEN DURATION WITH FULL BOTTLE (100% CAPACITY)									
STATED CYLINDER SIZE (CU FT)	**NUMBER OF PEOPLE USING								
	1	2	3	4	5	6	7	8	9
	DURATION IN MINUTES								
22	144	72	48	36	26	24	20	18	16
50	317	158	105	79	63	52	45	39	35
77	488	244	182	122	97	81	69	61	54
115	732	366	244	183	146	122	104	91	81
STATED CYLINDER SIZE (CU FT)	**NUMBER OF PEOPLE USING								
	10	11	12	13	14	15	**16	**17	
	DURATION IN MINUTES								
22	14	13	12	11	10	*	*	*	
50	31	28	26	24	22	21	19	18	
77	48	44	40	37	34	32	30	28	
115	73	66	61	56	52	48	45	43	

* Will not meet oxygen requirements.

** For oxygen duration computations, count each diluter-demand crew mask in use as two (e.g., with four passengers and a crew of two, enter the table at eight people using).

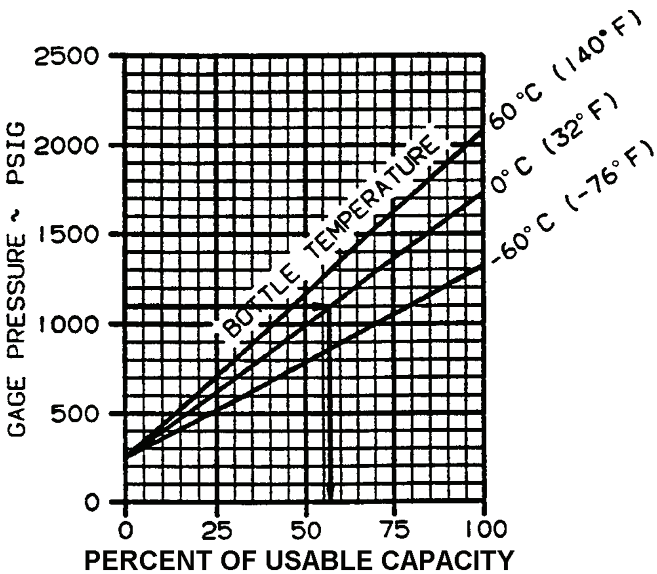


Figure 8A-1. Percent of Usable Capacity

e. Fuel **FIREWALL SHUTOFF VALVES** – **OPEN**.

f. **L** and **R FUEL PRESS** annunciators – Extinguished.

g. **STANDBY PUMPS – OFF**.

h. **L** and **R FUEL PRESS** annunciators – Illuminated.

i. **CROSSFEED FLOW –** Alternately **LEFT** and **RIGHT (FUEL CROSSFEED** annunciator illuminated, **L AND R FUEL PRESS** annunciators extinguished).

j. **CROSSFEED FLOW – OFF**.

k. Auxiliary fuel transfer – **AUTO**.

l. **NO TRANSFER** lights – **TEST** if not illuminated.

9. Fuel gauges – Check quantity.

★O*10. **EFIS POWER** switches and **INVERTER** – **ON**, check, **OFF**.

a. **EFIS POWER** switches**–** Push **ON**.

b. **INVERTER** – Turn **ON** either.

c. EADI and EHSI – Ensure both pilots' are fully operational.

d. **EFIS POWER** switches and **INVERTER** – **OFF**.

11. Subpanel – Check and set.

a. **MIC** switch – **NORMAL**.

b. **AVIONICS MASTER POWER – OFF**.

c. **INVERTER – OFF**.

d. **ENG AUTO IGNITION – OFF**.

e. **ICE VANES –** As required.

f. **AUTO FEATHER – OFF**.

g. **ALL** lights and **ICE PROTECTION** – Check then **OFF**.

(1) Lights, strobes and/or beacons, recognition, landing, taxi, navigation and ice – Check on, then **OFF**.

(2) Heat, stall warning, fuel vents and pitot – Check on, then **OFF**.

h. **LANDING GEAR RELAY** circuit breaker – Check in.

i. **LDG GEAR CONTROL – DN**.

j. **ANTICOLLISION LIGHTS – OFF**.

k. **GEAR DOWN** lights – Check illuminated.

l. **HYD FLUID SENSOR – TEST**.

(1) **TEST** switch – Hold in **TEST** position. **HYD FLUID LOW** annunciator illuminated.

NOTE

It takes approximately 8 seconds for the annunciator to illuminate and to extinguish after release.

(2) **TEST** switch – Release, **HYD FLUID LOW** annunciator extinguished.

m. **CABIN TEMP MODE – OFF**.

n. Fire detection system – Checked.

o. Stall and landing gear warning system – Check.

12. **FLAPS** – As desired.

13. **BATT** switch – **OFF**.

14. Galley power switches – **OFF**.

15. Toilet – Check.

16. Emergency equipment – Check that all required emergency equipment is available and that fire extinguishers and first aid kits have current inspection date.

a. Survival kit(s).

b. First aid kits (3).

c. Baggage compartment fire extinguisher.

d. Overhead emergency lighting (forward and aft).

e. Emergency exit.

f. Cockpit fire extinguisher.

8A-13. FUEL SAMPLE AND OIL CHECK.

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

NOTE

Fuel and oil quantity checks may be performed prior to Exterior Check to preclude carrying a ladder and fuel sample container during the balance of the preflight. During warm weather, open fuel caps slowly to prevent being sprayed by fuel under pressure.

1. Fuel Sample – Check collective fuel sample from all drains for possible contamination. (Refer to Chapter 2 for locations.)

NOTE

All exterior check areas are illustrated in Figure 8A-2.

8A-14. LEFT WING, AREA 1.

1. Left wing area – Check as follows:

* a. General condition – Check for skin damage such as buckling, splitting, distortion, dents, or fuel leaks.

b. Flaps – Check for full extension or retraction (approximately 1/4 inch play) and skin damage, such as buckling, splitting, distortion or dents.

c. Fuel sump drains – Check for leaks.

d. Ailerons and trim tab – Check security and trim tab rig.

e. Static wicks – Check security and condition.

f. Wing tip and position lights – Check condition and for cracked lens.

g. Recognition/strobe light – Check condition.

h. Outboard wing fuel vent – Check free of obstruction and fuel leakage.

* i. Main tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

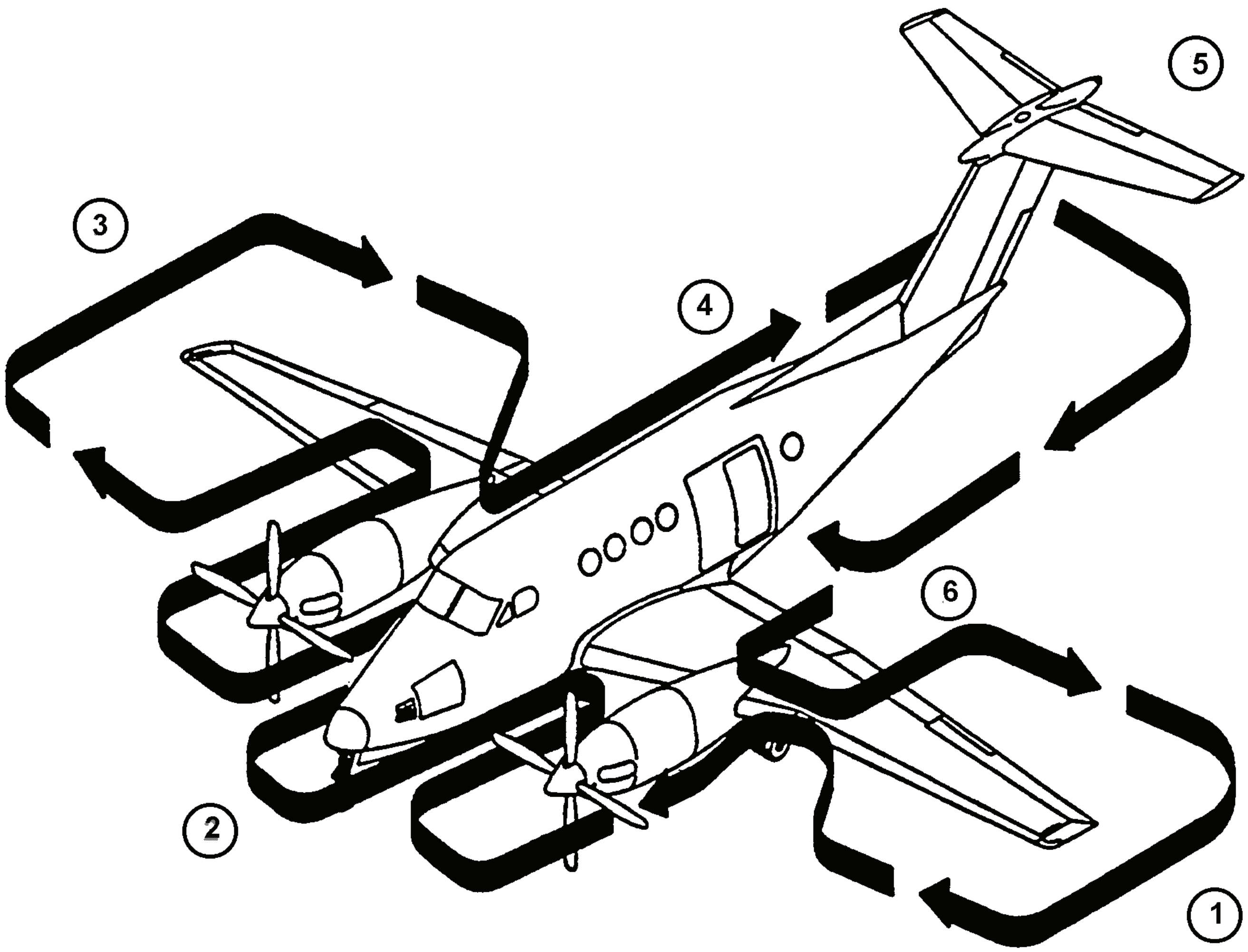
j. Outboard deice boot – Check for secure bonding, cracks, loose patches, stall strip.

k. Stall warning vane – Check free.

* l. Tiedown – Released.

m. Wing ice light – Check condition.

n. Recessed and heated fuel vents – Check free of obstructions.



AREA 1	LEFT WING LANDING GEAR, ENGINE, NACELLE, AND PROPELLER
AREA 2	NOSE SECTION
AREA 3	RIGHT WING LANDING GEAR, ENGINE, NACELLE, AND PROPELLER
AREA 4	FUSELAGE, RIGHT SIDE
AREA 5	EMPENNAGE
AREA 6	FUSELAGE, LEFT SIDE

Figure 8A-2. Exterior Check

2. Left main landing gear – Check as follows:

* a. Tires – Check for cuts, bruises, wear, appearance of proper inflation, wheel condition, and that both tires have the

same tread design.

b. Brake assembly – Check brake lines for damage or signs of leakage, and brake linings for wear. Also check the brake deice assembly and bleed air hose for condition and security.

* c. Shock strut – Check for signs of leakage, minimum strut extension (5.5 inches high floatation gear, 4 inches standard gear), and left and right extension is approximately equal.

d. Torque knee – Check condition.

e. Safety switch – Check condition, wire, and security.

f. Wheel well, doors, and linkage – Check for signs of leakage, broken wires, security and general condition.

g. Fuel sump drains – Check for leaks.

3. Left engine and propeller – Check as follows:

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

*a. Engine oil – Check oil level, normally no more than 3 quarts low, cap secured, and locking tab aft.

b. Engine compartment, left side – Check for fuel and oil leaks, security of oil cap, door, and general condition. Lock compartment access door.

c. Left cowl locks – Locked.

d. Left exhaust stub – Check for cracks and free of obstructions.

e. Propeller blades and spinner – Check blade condition, deice boot, security of spinner, and free propeller rotation.

f. Engine air inlets and ice vanes – Check free of obstruction and ice vane in the correct position.

g. Bypass door – Check condition and correct position.

h. Right cowl locks – Locked.

i. Right exhaust stub – Check for cracks and free of obstructions.

j. Engine compartment, right side – Check for fuel and oil leaks, ice vane linkage, door, and general condition. Lock compartment access door.

4. Left wing center section – Check as follows:

a. Heat exchanger inlet and outlet – Check for cracks and free of obstructions.

b. Auxiliary tank fuel sump drain – Check for leaks.

c. Hydraulic reservoir vent and pump seal drain – Check vent clear of obstructions, and no excessive fluid is present. Hydraulic landing gear service door secure.

d. Deice boot – Check for bonding, cracks, loose patches, and general condition.

*e. Auxiliary tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

5. Fuselage underside – Check as follows:

* a. General condition – Check for skin damage such as buckling, splitting, distortion, dents, or fuel leaks.

b. Antennas – Check security and general condition.

c. TAS probe – Check security and condition.

8A-15. NOSE SECTION, AREA 2.

1. Nose section – Check as follows:

a. Outside air temperature probe – Check condition.

b. Avionics door, left side – Check secure.

c. Air conditioner exhaust – Check free of obstruction.

d. Wheel well condition – Check for signs of leakage, broken wires, and condition.

e. Doors and linkage – Check condition, security, and alignment.

f. Nose gear turning stop – Check condition.

* g. Tire – Check for cuts, bruises, wear, appearance of proper inflation, and wheel condition.

* h. Shock strut – Check for signs of leakage and 3 inches minimum extension.

i. Torque knee – Check condition.

j. Shimmy damper and linkage – Check for security and condition.

O k. Headset jack cover – Check.

l. Landing and taxi lights – Check for security and condition.

m. Pitot tubes – Check covers removed, alignment, security, and free of obstructions.

n. Radome – Check condition.

CAUTION

Do not move wipers on dry windshield or clean windshield with anything other than mild soap and water.

o. Windshields and wipers – Check windshields for cracks and cleanliness, and wipers for contact with glass surface.

p. Air conditioner inlet – Check free of obstructions.

q. Avionics door, right side – Check secure.

8A-16. RIGHT WING, AREA 3.

1. Right wing center section – Check as follows:

a. Deice boot – Check for secure bonding, cracks, loose patches, and general condition.

b. Battery access panel – Secure.

c. Battery exhaust louvers – Check free of obstructions.

*d. Auxiliary tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

e. Battery compartment drain – Check free of obstruction and check-valve free.

f. Battery ram air intake – Check free of obstruction.

g. Auxiliary tank fuel sump drain – Check for leaks.

h. Heat exchanger outlet and inlet – Check for cracks and free of obstructions.

2. Right engine and propeller – Check as follows:

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

* a. Engine oil – Check oil level, no more than 3 quarts low, cap secure, and locking tab aft.

b. Engine compartment, left side – Check for fuel and oil leaks, security of oil cap, door and general condition. Lock compartment access door.

c. Left cowl locks – Locked.

d. Left exhaust stub – Check for cracks and free of obstructions.

e. Propeller blades and spinner – Check blade condition, security of deice boot, spinner security, and free propeller rotation.

f. Engine air inlets and ice vane – Check free of obstruction and in the correct position.

g. Bypass door – Check cond. and position.

h. Right cowl locks – Locked.

i. Right exhaust stub – Check for cracks and free of obstructions.

j. Engine compartment, right side – Check for fuel and oil leaks, ice vane linkage, door, and general condition. Lock compartment access door.

3. Right main landing gear – Check as follows:

a. Fuel sump drains – Check for leaks.

*b. Tires – Check for cuts, bruises, wear, appearance of proper inflation, wheel condition, and that both tires have the same tread design.

c. Brake assembly – Check lines for damage or signs of leakage, and brake linings for wear. Also check brake deice assembly and bleed-air hose for condition and security.

* d. Shock strut – Check for signs of leakage and minimum strut extension (5.5 inches high floatation gear, 4 inches standard gear), and left and right extension is approximately equal.

e. Torque knee – Check condition.

f. Safety switch – Check condition, wire, and security.

g. Wheel well, doors, and linkage – Check for signs of leakage, broken wires, security, and general condition.

4. Right wing – Check as follows:

a. Recessed and heated fuel vents – Check free of obstructions.

b. GPU access door – Secured.

c. Wing ice light – Check condition.

d. Outboard deice boot – Check for secure bonding, cracks, loose patches, stall strip, and general condition.

* e. Tiedown – Released.

* f. Main tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

g. Outboard wing fuel vent – Check free of obstruction and fuel leakage.

h. Wing tip and position light – Check condition and for cracked lens.

i. Recognition/strobe light – Check condition.

j. Static wicks – Check security and condition.

k. Ailerons and trim tab – Check security and condition of ground adjustable tab.

l. Fuel sump drains – Check for leaks.

m. Flaps – Check for full extension or retraction (approximately 1/4 inch play) and skin damage such as buckling, splitting, distortion, or dents.

* n. General condition – Check for skin damage such as buckling, splitting, distortion, dents, or fuel leaks.

8A-17. FUSELAGE RIGHT SIDE, AREA 4.

1. Fuselage right side – Check as follows:

* a. General condition – Check for skin damage such as buckling, splitting, distortion, or dents.

b. Beacon – Check condition.

c. Aft access door – Check condition.

O d. Cabin air exhaust – Clear.

e. Oxygen filler door – Check secure.

f. Static ports – Check clear of obstructions.

g. Emergency locator transmitter – Armed and antenna check.

8A-18. EMPENNAGE, AREA 5.

1. Empennage – Check as follows:

a. Vertical stabilizer, rudder, and trim tab – Check for skin damage such as buckling, splitting, distortion, or dents, and trim tab rig.

b. Antennas – Check condition.

c. Deice boots – Check for secure bonding, cracks, loose patches, and general condition.

WARNING

If the possibility of ice accumulation on the horizontal stabilizer or elevator exists, do not take off.

d. Horizontal stabilizer, elevator, and trim tab – Check for skin damage such as buckling, splitting, distortion, or dents, and trim tab rig.

e. Elevator trim tab – Verify "0" (neutral) position. The elevator trim tab "0" (neutral) position is determined by observing that the trailing edge of the trim tab aligns with the trailing edge of the elevator while the elevator is resting against the downstops.

f. Static wicks – Check.

g. Position and beacon lights – Check

8A-19. FUSELAGE LEFT SIDE, AREA 6.

1. Fuselage left side – Check as follows:

* a. General condition – Check for skin damage such as buckling, splitting, distortion, or dents.

b. Static ports – Check clear of obstructions.

c. Cabin door – Check seal and general condition.

d. Fuselage top side – Check general condition.

* 2. Chocks and tiedowns – Removed.

***8A-20. INTERIOR CHECK.**

1. Cargo/loose equipment – Check secure.

CAUTION

Ferry fuel tank caps shall be properly secured to prevent fuel fumes from escaping into the cabin.

★ O 2. Ferry fuel tanks and caps – Visually check fuel level of each tank, condition of seal, and that cap is tight and properly installed. Check tiedowns and platform assemblies to determine if tanks are securely installed.

O 3. Ferry fuel tank selector valve(s) – Closed.

★ 4. Cabin door – Locked and checked. Ensure the cabin door is closed and locked as follows: Check position of safety arm and diaphragm plunger (lift door step) and each of the six rotary cam locks align within the orange sight indicators. In addition, the following inspection and test shall be performed prior to the first flight of the day:

a. Cabin door – Open. Check that **CABIN DOOR** annunciator is extinguished.

b. Cabin door – Latch but do not lock. Check that **CABIN DOOR** annunciator illuminates.

c. **BATT** switch – **ON**. Check that **CABIN DOOR** annunciator is still illuminated.

d. Cabin door – Close and lock. Check that **CABIN DOOR** annunciator is extinguished.

e. **BATT** switch – **OFF**.

5. Cargo door – Check and lock. Ensure cargo door is closed and locked as follows:

a. Upper handle position – Closed and locked (orange index marks on each of the four rotary cam locks must align within the sight indicators).

b. Lower pin latch handle position – Closed and latched (orange indicator must align with orange stripe on carrier rod).

NOTE

The untapered shoulder of the latching pins should extend past each attachment lug.

6. Emergency exit – Check.

★ 7. Crew/passenger briefing – Complete.

8A-21. BEFORE STARTING ENGINES.

NOTE

GPU engine starts are the preferred starting method.

* 1. Parking brake – Set.

* 2. Oxygen system – Set.

3. Circuit breakers – Check.

* 4. Overhead panel – Check.

* 5. Fuel panel switches – Check.

6. Magnetic compass – Check.

O 7. Clock and map lights – **OFF**.

* 8. Pedestal controls – Set.

a. **POWER** levers – **IDLE**.

b. **PROP** levers – **HIGH RPM**.

NOTE

Where excessive gravel/debris is present, or the ramp is slippery, the pilot may consider starting the engines with the props in feather, but must closely monitor ITT on engine start.

c. **CONDITION** levers – **FUEL CUTOFF**.

d. Trim tabs – Set.

9. Lower console switches – Set.

a. Avionics – As required.

b. **RUDDER BOOST** switch – **ON**.

10. Gear ratchet handle – Stowed.

11. Free air temperature gauge – Check.

12. Pilot’s instrument panel – Check and set.

a. Compass control – **SLV**.

O b. **EFIS POWER** – **OFF**.

O c. **STBY HORIZ PWR – TEST, ON,** and Uncaged.

13. Copilot's instrument panel – Check and set.

a. Compass control – **SLV**.

14. **ICE VANE** switches – As required.

* 8A-22. FIRST ENGINE START (BATTERY START).

Starting procedures are identical for both engines except the second engine generator is kept off line after the second engine start to allow performing the current limiters check. When making a battery start, the right engine should be started first. A crewmember should monitor the outside observer throughout the engine start.

1. **BATT** switch – **ON** (22 volts minimum).
2. Exterior **LIGHTS** – As required.
3. Propeller area – Clear.
4. Engine – Start.

CAUTION

If ignition does not occur within 10 seconds after moving the condition lever to LOW IDLE initiate Engine Clearing procedure, Paragraph 8A-25. If for any reason the starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1 minute minimum).

a. **IGNITION AND ENGINE START** switch – **ON**. **IGN ON** annunciator should illuminate and associated **FUEL PRESS** annunciator extinguished.

b. **CONDITION** lever (after N_1 stabilizes at or above 12% for 5 seconds minimum) – **LOW IDLE**.

CAUTION

Monitor ITT to avoid a hot start. If there is a rapid rise in ITT, be prepared to abort the start before limits are exceeded. During starting, the maximum allowable ITT is l000 ºC for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8A-24, and discontinue start. Record the peak temperature and duration on DA Form 2408-13-1.

c. **ITT** and N_1 – Monitor. **ITT** 1000 °C maximum. N_1 minimum 58%.

d. Oil pressure – Check (60 psi minimum).

e. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT decreasing.

5. Engine and systems instruments – Check.
6. **CONDITION** lever – **HIGH IDLE**. Monitor **ITT** as the condition lever is advanced.

NOTE

Ensure N_1 is at high idle before turning on generator.

7. **GEN** switch – **RESET**, then **ON**.

a. **BATTERY CHG** annunciator – Monitor.

NOTE

The ICE VANE switch should be set to EXTEND for all ground operations to minimize ingestion of ground debris. Set switch to RETRACT to maintain engine temperatures within limits.

* 8A-23. SECOND ENGINE START (BATTERY START).

1. First engine generator load – 50% or less – **GEN** switch **OFF**.
2. Propeller area – Clear.
3. Engine – Start.

a. **IGNITION AND ENGINE START** switch – **ON**. **IGN ON** light should illuminate and **FUEL PRESS** light should extinguish.

CAUTION

If ignition does not occur within 10 seconds after moving the condition lever to LOW IDLE, initiate Engine Clearing procedure, Paragraph 8A-25. If for any reason the starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

b. First engine **GEN** switch – **RESET** then **ON** when N_1 reaches 12%.

c. **CONDITION** lever (after N_1 stabilizes at or above 12% for 5 seconds minimum) – **LOW IDLE**.

CAUTION

Monitor ITT to avoid a hot start. If there is a rapid rise in ITT, be prepared to abort the start before limits are exceeded. During starting, the maximum allowable ITT is 1000 °C for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8A-24, and discontinue start. Enter the peak temperature and duration on DA Form 2408-13-1.

d. **ITT** and N_1 – Monitor. **ITT** 1000 °C maximum. N_1 minimum 58%.

e. Oil pressure – Check (60 psi minimum).

f. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT is decreasing.

4. Engine and systems instruments – Check.

5. **BATTERY CHG** annunciator – Check.

6. **INVERTER** switch – **ON**, check **INVERTER** lights **OFF**.

   a. Check the operation of the **INVERTER** to be used as the standby **INVERTER**, then **OFF**; turn **ON** the **INVERTER** to be used for the flight.

7. Second engine **GEN** switch – **RESET**, then **ON**.

   a. AC/DC power – Check frequencies, volts and loads.

   b. Frequency and volts:

      (1) AC frequency 390 Hz to 410 Hz.

      (2) AC voltage – 110 Vac to 120 Vac.

      (3) DC voltage – 27.5 to 29.0 Vdc.

   c. DC loads: Parallel within 10%.

      (1) 75% maximum – Low Idle.

      (2) 85% maximum – High Idle.

      (3) 85% maximum – Ground Operations.

8. **CONDITION** levers – As required.

9. **RED ANTICOLLISION** light – Reset.

NOTE

To reset, turn off the RED ANTI-COLLISION light approximately 5 seconds, then back ON. When voltage drops below approximately 20 volts, the anticollision light may become inoperative. Normally, the RED ANTI-COLLISION light is used for ground operations and the WHITE ANTICOLLISION light is used for flight operations.

8A-24. ABORT START.

1. **CONDITION** lever – **FUEL CUTOFF**.

2. **IGNITION AND ENGINE START** switch – **STARTER ONLY**.

3. **ITT** – Monitor for drop in temperature.

4. **IGNITION AND ENGINE START** switch – **OFF**.

8A-25. ENGINE CLEARING.

1. **CONDITION** lever – **FUEL CUTOFF**.

2. **IGNITION AND ENGINE START** switch – **OFF** (1 minute minimum).

CAUTION

Do not exceed starter limitation of 40 seconds on and 60 seconds off for two starting attempts and Engine Clearing procedure, Paragraph 8A-25. Allow 30 minutes off before additional starter operation.

3. **IGNITION AND ENGINE START** switch – **STARTER ONLY** (15 seconds minimum, 40 seconds maximum).

4. **IGNITION AND ENGINE START** switch – **OFF**.

* 8A-26. FIRST ENGINE START (GPU START).

When making a GPU start, the left engine should be started first due to the GPU receptacle's being located adjacent to the right engine. Normally, only one engine is started using the GPU, reverting to a battery start procedure for the second engine start.

CAUTION

Never connect an external power source to the aircraft unless a battery indicating a charge of at least 20 volts is in the aircraft and in the ON position. If the battery voltage is less than 20 volts, the battery must be recharged, or replaced with a battery indicating at least 20 volts before connecting external power. Use only an external power source fitted with an AN-type plug.

The battery should be on to absorb transients present in some auxiliary power units. An **EXT PWR** annunciator alerts the crew when an external power plug is connected to the aircraft.

NOTE

If the battery is partially discharged, the BATTERY CHG annunciator will illuminate approximately 6 seconds after external power is on line. If the annunciator does not extinguish within 5 minutes, refer to the Battery Chg Annunciator Illuminated procedure in Chapter 9.

1. **BATT** switch – **ON**.
2. GPU – Connect.
3. **EXTERNAL POWER** advisory light – **ON**.
4. Exterior **LIGHTS** switches – As required.
5. Propeller area – Clear.
6. Engine – Start.

CAUTION

If ignition does not occur within 10 seconds after moving the condition lever to LOW IDLE, initiate Engine Clearing procedure, Paragraph 8A-25. If for any reason the starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

   a. **IGNITION AND ENGINE START** switch – **ON**. **IGN ON** light illuminated and associated **FUEL PRESS** light extinguished.

   b. **CONDITION** lever (after N_1 stabilizes at or above 12% for 5 seconds) – **LOW IDLE**.

CAUTION

Monitor ITT to avoid a hot start. If there is a rapid rise in ITT, be prepared to abort the start before limits are exceeded. During engine start, the maximum allowable ITT is 1000 °C for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8A-24, and discontinue start. Record the peak temperature and duration on DA Form 2408-13-1.

   c. **ITT** and N_1 – Monitor. **ITT** 1000 °C maximum. N_1 minimum 58%.

   d. Oil pressure – Check (60 psi minimum).

   e. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT decreasing.

7. Engine and systems instruments – Check.
8. **CONDITION** lever – **HIGH IDLE**. Monitor **ITT** as the condition lever is advanced.
9. GPU – Disconnect or as required.

CAUTION

Do not turn on generators with GPU connected.

10. **GEN** switch (after GPU disconnected) – **RESET** then **ON**.
11. **BATTERY CHG** annunciator – Monitor.

NOTE

After starting the first engine with a GPU, the second engine is normally started using a battery start. If a GPU start is required or desired for the second engine start, follow the Second Engine Start (GPU Start) procedure, Paragraph 8A-27. Otherwise, follow Second Engine Start (Battery Start) procedure, Paragraph 8A-23.

*** 8A-27. SECOND ENGINE START (GPU START).**

1. Propeller area – Clear.
2. Engine – Start.

   a. **IGNITION AND ENGINE START** switch – **ON**. **IGN ON** light illuminated and the associated **FUEL PRESS** light extinguished.

CAUTION

If ignition does not occur within 10 seconds after moving condition lever to low idle, initiate Engine Clearing procedure, Paragraph 8A-25. If for any reason a starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

b. **CONDITION** lever (after N_1 RPM stabilizes at or above 12% for 5 seconds) – **LOW IDLE**.

CAUTION

Monitor ITT to avoid a hot start. If there is a rapid rise in ITT, be prepared to abort the start before limits are exceeded. During engine start, the maximum allowable ITT is 1000 °C for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8A-24, and discontinue start. Record the peak temperature and duration on DA Form 2408-13-1.

c. **ITT** and N_1 – Monitor. **ITT** 1000 °C maximum. N_1 minimum 58%.

d. Oil pressure – Check (60 psi minimum).

e. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT decreasing.

3. Engine and systems instruments – Check.

4. Right **PROP** lever – **FEATHER**.

5. GPU – Disconnect.

6. Right **PROP** lever – **HIGH RPM**.

7. **INVERTER** switch – **ON**, check **INVERTER** light **OFF**.

a. Check the operation of the **INVERTER** to be used as the standby **INVERTER**, then **OFF**; turn **ON** the **INVERTER** to be used for the flight.

8. **GEN** switches – **RESET**, then **ON**.

a. AC/DC power – Check frequencies, volts and loads.

b. Frequency and volts:

(1) AC frequency 390 Hz to 410 Hz.

(2) AC voltage – 110 Vac to 120 Vac.

(3) DC voltage – 27.5 Vdc to 29.0 Vdc.

c. DC loads: Parallel within 10%.

(1) 75% maximum – **LOW IDLE**.

(2) 85% maximum – **HIGH IDLE**.

(3) 85% maximum – Ground operations.

9. **CONDITION** levers – As required.

10. **RED ANTICOLLISION** light – Reset.

NOTE

To reset, turn off approximately 5 seconds, then to the NIGHT (red) position. When voltage drops below approximately 20 volts, the anticollision light may become inoperative. Normally, NIGHT (red) strobe is used for ground operations and DAY (white) is used for flight operations.

8A-28. BEFORE TAXIING.

*1. **AC/DC** power – Check.

*2. **AVIONICS MASTER POWER – ON**.

O *3. **EFIS POWER** switches **– ON**.

*4. **CABIN TEMP MODE** and temperature switch – Set as desired.

*5. **BLEED AIR VALVES** – As required.

CAUTION

Do not leave brake deice on longer than required to check function of annunciators when ambient temperatures are above 15° C.

NOTE

Brake deice control valves may become inoperative if valves are not cycled periodically. One cycle of the valves is required daily regardless of the weather conditions.

*6. **BRAKE DEICE –** As required.

*7. Avionics – Check and set as required.

O *8. **TCAS – TEST** and set.

9. **FLAPS –** Check.

*10. Altimeters – Set and check.

11. **ICE VANES** – As required.

★ 12. **GND IDLE STOP** – Check.

a. Ensure prop RPM is >1150, **CONDITION**

LEVERS – **HIGH IDLE**.

b. **GND IDLE STOP** test switch – Hold in TEST position.

c. Check Prop RPM decrease - not more than 250 RPM

d. **GND IDLE STOP** test switch – Release. Ensure prop RPM increases to original RPM.

*** 8A-29. TAXIING**.

CAUTION

Never taxi with a flat tire or a flat shock strut. During taxi operations, particular attention should be given to propeller tip clearance. Extreme caution is required when operating on unimproved or irregular surfaces or when high winds exist. If operations produce a propeller RPM over 1600, retard propeller levers to the detent to limit RPM to 1600 to help reduce the possibility of ingestion of ground debris.

1. Brakes – Check.
2. Flight instruments – Check.

8A-30. ENGINE RUNUP.

1. Parking brake – As required.
2. Manual prop feathering – Check.

★ 3. **AUTOFEATHER/AUTO IGNITION** – Check as required.

a. **AUTO IGNITION** switches – **ARM**. **IGNITION ON** annunciators illuminated.

b. **POWER** levers – 500 ft-lb. **IGNITION ON** annunciators extinguish.

c. **AUTOFEATHER** switch – Hold to **TEST**. Both **AUTOFEATHER** annunciators illuminated.

d. **POWER** levers – Retard individually.

(1) Approximately 400 ft-lb torque, opposite **AUTOFEATHER** annunciator extinguished, **IGNITION ON** annunciator illuminated.

(2) Approximately 260 ft-lb torque, both **AUTOFEATHER** annunciators extinguished (prop begins to feather).

NOTE

AUTOFEATHER annunciators will illuminate and extinguish with each fluctuation of torque as the propeller attempts to feather.

(3) Return **POWER** levers to approximately 500 ft-lb torque.

e. Repeat procedure with other engine.

f. **POWER** levers – **IDLE**.

g. **AUTOFEATHER** switch – **ARM**.

h. **AUTO IGNITION** switches – Off.

★ 4. Overspeed governors and rudder boost – Check as required.

a. **RUDDER BOOST** switch – On.

b. **PROP** levers – **HIGH RPM**.

c. **PROP GOV TEST** switch – Hold in **TEST** position.

d. Left **POWER** lever – Increase until propeller is stabilized at 1830 – 1910 RPM. Continue to increase until rudder movement is noted. Observe **ITT** and torque limits; and **PROP** remains stabilized at 1830 – 1910 RPM.

e. **POWER** lever – Retard to **IDLE**.

f. Repeat steps c, d, and e for the right engine.

★ 5. Primary governors – Check as required.

a. **POWER** levers – Set 1800 RPM.

b. **PROP** levers – Retard carefully to **FEATHER** detent. Note propellers stabilize between 1600 and 1640 RPM.

c. **PROP** levers – **HIGH RPM**. Note propellers return to 1800 RPM.

★ 6. **ICE VANES** – Check. If already extended, reverse steps a and b.

a. **ICE VANES** – **EXTEND**.

(1) Both advisory lights illuminated.

(2) Both bypass doors extended.

(3) Maximum time for (1) and (2) is 15 seconds.

b. **ICE VANES** –**RETRACT**.

(1) Both advisory lights extinguish.

(2) Both bypass doors retracted.

(3) Maximum time for (1) and (2) is 15 seconds.

7. **CONDITION** levers – **HIGH IDLE**.

8. **POWER** levers – **IDLE**.

★ 9. Anti-ice/deice systems – Check.

a. **PROP** deice – Check. When **MANUAL** mode is selected, note rise on DC loadmeter. When **AUTO** mode is selected, monitor prop ammeter for 90 seconds and ensure the indicator remains in the normal operating range the entire time.

b. **WSHLD ANTI-ICE** – Check. Note increases on the loadmeter and cycle through both normal and high settings.

NOTE

If windshield heat is needed prior to takeoff, use NORMAL setting for a minimum of 15 minutes prior to selecting HIGH to provide adequate preheating and minimize the effects of thermal shock. The windshield heat thermostat will invalidate the check in OAT above 20 to 30 °C.

c. All anti-ice/deice switches – **OFF**.

d. Surface deice system – Check.

★ 10. Vacuum and pneumatic system – Check.

a. **LEFT BLEED AIR VALVE** – **OFF**.

(1) Pneumatic and suction pressures remain normal.

(2) **L BL AIR OFF** annunciator illuminates.

(3) Both **BL AIR FAIL** annunciators remain extinguished.

b. **RIGHT BLEED AIR VALVE** – **OFF**.

(1) Pneumatic and suction pressures read zero.

(2) Both **BL AIR OFF** and **BL AIR FAIL** annunciators illuminated.

c. **LEFT BLEED AIR VALVE** – **ON**.

(1) Pneumatic and suction pressures return to normal.

(2) Both **BL AIR FAIL** annunciators extinguished.

(3) **L BL AIR OFF** annunciator extinguished.

d. **RIGHT BLEED AIR VALVE** – **ON**.

(1) **R BL AIR OFF** annunciator extinguished.

★ 11. Automatic flight control system – Check.

a. **AP/FD** – On.

b. Press the red **DISC** button – Ensure AP/YD disconnects.

If the crew determines to check the AP more completely, turn on the AP/YD and continue with steps c through p.

c. Autopilot controller **TRIM UP**, **TRIM DN** Annunciators – Check not illuminated. A steady illumination of **TRIM UP** or **TRIM DN** annunciator indicates that automatic synchronization is not functioning and autopilot should not be engaged.

d. Turn knob – In center detent position.

e. Elevator trim control switch – **ON**.

f. Control wheel – To mid travel.

g. Autopilot controller **AP** button – Press. **AP ENGAGE** and **YD ENGAGE** annunciators on autopilot controller will flash. Servo clutches will engage. **FD** flag on ADI in view.

h. Control movement – Check when pushed **ON**.

WARNING

If autopilot or yaw damper disengages during overpower test, do not use. If AP ENGAGE or YD ENGAGE annunciator continues to flash, do not use.

i. Rudder pedals – Overpower slowly. **YD ENGAGE** annunciator stops flashing. **FD** flag retracts.

j. Elevator trim follow-up – Check.

k. Control wheel – Hold aft of mid travel. Trim wheel should run nose down after approximately 3 seconds. Trim down annunciator should illuminate after approximately 8 seconds.

l. Control wheel – Hold forward of mid travel. Trim wheel should run nose up after approximately 3 seconds. **TRIM UP** annunciator should illuminate after approximately 8 seconds, and **AP TRIM FAIL** annunciator and **MASTER WARNING** flasher should illuminate after approximately 15 seconds.

m. **AP/YD & TRIM DISC** button – Press through second level. Autopilot and yaw damper should disengage and **ELECT TRIM OFF** annunciator should illuminate. **AP ENGAGE** and **YD ENGAGE** annunciators on instrument panel should flash five times and autopilot off aural alert should sound for 1 second.

n. **MASTER WARNING** flasher – Press to reset.

WARNING

Operation of the electric trim switch system should occur only by movement of pairs of switches. Any movement of the elevator trim wheel while pressing only one switch element denotes a trim system malfunction. The AP/TRIM POWER switch must be turned OFF and flight conducted only by manual operation of the trim wheel. Do not use autopilot.

o. Elevator trim control switch – **OFF**, then **ON** (resets electric trim; **ELECT TRIM OFF** annunciator should extinguish).

p. Electric elevator trim – Check.

(1) Elevator trim control switch – **ON**.

(2) Pilot and copilot trim switches – Check.

(3) Pilot and copilot. Check individual element for no movement of trim and check proper operation of both elements.

(4) Check pilot switches override copilot switches while trimming in opposite directions and trim moves in direction commanded by pilot.

(5) Check pilot and copilot trim disconnects while activating trim.

(6) Elevator trim switch – **OFF** and **ON** (**ELECT TRIM OFF** annunciator extinguishes).

★ 12. Pressurization – Check and set.

a. **BLEED AIR VALVES** – Both **ON**.

b. **CABIN ALTITUDE** – Set 500 feet lower than field pressure altitude.

c. **CABIN PRESS** switch – **TEST**. Cabin climb/descent gauge indicates a descent.

d. **CABIN PRESS** switch – Release. Cabin climb/descent gauge indicates a climb, then stabilizes at zero climb.

e. Altitude selector – Set as required. Pressure altitude + 200 feet.

13. **CONDITION** levers – As desired.

14. EGPWS/GPWS – Check.

* 8A-31. BEFORE TAKEOFF.

1. **AUTOFEATHER** switch – **ARM**.
2. **BLEED AIR VALVES** – As required.
3. Fuel panel – Check fuel quantity and position . of switches.
4. Flight and engine instruments – Check.
5. **CABIN CONTROLLER** – Set.
6. Annunciator panels – Check.
7. **PROP** levers – **HIGH RPM**.
8. **FLAPS** – As required.
9. Trim and AP – Set. AP control set to PF's FD.
10. Avionics – Set.
11. Flight controls – Check.
12. ★ Departure briefing – Complete.
13. **CABIN** signs – As required.

* 8A-32. LINE UP.

1. **ICE PROTECTION** switches – As required.
2. Altitude alerter – Check.
3. O Transponder / TCAS / Wx Radar – As required.
4. **ENG AUTO IGNITION** – **ARM**.
5. Lights – As required.
6. **CONDITION** levers – **HIGH IDLE**.
7. **POWER –** Stabilized 600 ft-lb minimum.
8. PF's Heading Bug – Sync to runway heading.

8A-33. TAKEOFF.

To aid in planning the takeoff and to obtain maximum aircraft performance, make full use of the information affecting takeoff shown in Chapter 7. The data shown was achieved by setting brakes, setting takeoff power, and then releasing brakes, but this method is not required. The takeoff will be accomplished in accordance with the appropriate Aircrew Training Manual (ATM). The PNF operates the PF's controls on the extended pedestal from the beginning of the takeoff roll until the After Takeoff checklist is completed or the Autopilot is engaged, whichever comes first.

8A-34. AFTER TAKEOFF.

WARNING

During takeoff and climb, the pilot flying the aircraft should avoid adjusting controls located on the aft portion of the extended pedestal to preclude inducing spatial disorientation.

1. **GEAR** – **UP**.
2. **FLAPS** (105 KIAS) – **UP**.
3. **LANDING/TAXI** lights – **OFF**.
4. Climb power – Set.

8A-35. CLIMB.

a. Cruise Climb. Cruise climb is performed at a speed that is the best combination of climb, fuel burn-off, and distance covered. Set propellers at 1900 RPM and torque at maximum allowable (or maximum climb ITT, monitor N_1). Adhere to the following airspeed schedule as closely as possible:

SL to 10,000 feet....………..…………160 KIAS

10,000 to 20,000 feet………………...140 KIAS

20,000 to 25,000 feet………………...130 KIAS

25,000 to 35,000 feet………………..120 KIAS

b. Climb – Maximum Rate. Maximum rate of climb performance is obtained by setting propellers at 2000 RPM, torque at maximum allowable (or maximum **ITT**, monitor N_1), and maintaining best rate-of-climb airspeed. Refer to Chapter 7 for best rate-of-climb airspeed (V_y) for specific weights.

c. Climb Checklist. Complete as follows:

1. **YD** – As required.
2. Cabin pressurization – Check. Adjust rate control knob so that cabin rate-of-climb equals one third of aircraft rate-of-climb. Recommend setting cruise altitude + 1000 feet.
3. **AUTOFEATHER** – As required.
4. **BRAKE DEICE** – As required.

NOTE

Turn the windshield heat on to NORMAL when passing 10,000 feet MSL or prior to entering the freezing level, whichever comes first. Leave on until no longer required during descent for landing. HIGH temperature may be selected as required after a minimum warmup period of 15 minutes.

5. **WSHLD ANTI-ICE** – As required.
6. Wings and nacelles – Check.
7. O **TCAS** – Set range.

8A-36. CRUISE.

1. **POWER** – Set. Refer to the cruise power graphs contained in Chapter 7.

NOTE

A new engine operated at the torque value presented in the cruise power charts will show an ITT margin below the maximum cruise limit for the torque value presented in the charts. With ice vanes retracted (ICE VANES OFF), if cruise torque settings shown on the power charts cannot be obtained without exceeding ITT limits, the engine should be inspected.

2. **ICE PROTECTION** switches – As required. Ensure anti-ice equipment is activated before entering icing conditions.
3. **CABIN** signs – As required.
4. **AUXILIARY** fuel gauges – Monitor. Ensure fuel is being transferred from auxiliary tanks. (Chapter 2, Section IV).
5. Altimeters – Check. Verify altimeter settings are correct.
6. Engine instruments – Check. Note indications.
7. **RECOG** lights – As required.
8. O **TCAS** – Set for en route.

8A-37. DESCENT – ARRIVAL.

Perform the following checks prior to the descent into the terminal area for landing.

1. Cabin pressurization – Set. Adjust cabin controller dial as required.
2. **CABIN** signs – As required.
3. **ICE PROTECTION** switches – As required.

NOTE

Set windshield heat to NORMAL or HIGH as required well before descent into icing conditions or into warm moist air to aid in defogging. Turn off windshield heat when descent is completed to lower altitudes and when heating is no longer required. This will preclude possible windshield distortions.

4. **WSHLD ANTI-ICE** – As required.
5. **RECOG** lights – **ON**.
6. Radar altimeters – As required.
7. Altimeters – Set to current setting.

O 8. **TCAS** – Set as required.

★ 9. Arrival briefing – Complete.

8A-38. DESCENT.

Descent from cruise altitude should normally be made by letting down at cruise airspeed with reduced power. Refer to Chapter 7 for power settings and rates of descent.

NOTE

Cabin pressure controller should be adjusted prior to starting descent.

a. Descent – Maximum Rate (Clean). To obtain the maximum rate of descent in clean configuration, perform the following:

1. Cabin pressurization – Set. Adjust cabin controller dial as required. While descending, adjust rate control knob so that cabin rate of descent equals one-third aircraft rate of descent.
2. **CABIN** signs – As required.
3. **POWER** levers – **IDLE**.
4. **PROP** levers – **HIGH RPM**.
5. **GEAR – UP**.
6. **FLAPS – UP**.
7. Airspeed – V_{mo} maximum.
8. **ICE PROTECTION** switches – As required.
9. **RECOG** lights – As required.

O 10. Ferry fuel caps – Loosen or remove if rate of descent exceeds 1500 fpm.

b. Descent – Maximum Rate (Landing Configuration). If required to descend at a low airspeed (e.g., to conserve airspace or in turbulence), approach flaps and landing gear may be extended to increase the rate and angle of descent while maintaining a slower airspeed. To perform, use the following procedure:

1. Cabin pressurization – Set. Adjust cabin controller dial as required. While descending, adjust rate control knob so that cabin rate of descent equals one-third aircraft rate of descent.
2. **CABIN** signs – As required.
3. **POWER** levers – **IDLE**.
4. **PROP** levers – **HIGH RPM**.
5. **FLAPS – APPROACH**.
6. **GEAR – DN**.
7. Airspeed – 181 KIAS maximum.
8. **ICE PROTECTION** switches – As required.
9. **RECOG** lights – As required.

O 10. Ferry fuel caps – Loosen or remove if rate of descent exceeds 1500 fpm.

8A-39. APPROACH.

1. **HSI NAV SOURCE** – As required.
   a. Ensure the correct navigational source for the approach has been selected.

O 2. **TCAS** – Set as required.

8A-40. BEFORE LANDING.

1. **CABIN** Signs – **NO SMOKE & FSB**.
2. **AUTOFEATHER – ARM**.
3. **BRAKE DEICE** – As required.
4. **PROP** levers – As required.

NOTE

During approach, propellers should be set at 1900 RPM to prevent glideslope interference (ILS approach), provide better power response during approach, and minimize attitude change when advancing propeller levers for landing.

5. **FLAPS** (below 200 KIAS) – **APPROACH**.
6. **GEAR** (below 181 KIAS) – **DN**/confirm.
7. **LANDING/TAXI LIGHTS** – As required.
8. **CONDITION** levers – **HIGH IDLE**.

O 9. **TCAS** – Set as required.

8A-41. LANDING.

Performance data charts for landing computations assume the runway is paved, level, and dry. Additional runway must be allowed when these conditions are not met. Do not consider headwind during landing computations. However, if landing must be downwind, include the tailwind in landing distance computation. Conduct all landings in accordance with the ATM. Perform the following procedure as the aircraft nears the runway:

1. **AP & YD** – Disengaged.
2. **GEAR DOWN** lights – Check/confirm.
3. **PROP** levers – **HIGH RPM**.

8A-42. TOUCH AND GO LANDING.

The instructor should select a point on the runway where all pre-takeoff procedures will have been completed prior to the pilot's initial application of power. In selecting this point, prime consideration shall be given to the required accelerate-stop distance pre-computed on a current Performance Planning Card. The nose wheel should be on the runway and rolling straight before the power is advanced. After the pilot applies power to within 5% of the takeoff power, the instructor's actions are the same as during a normal takeoff. Use the following procedure:

1. **PROP** levers – **HIGH RPM**.
2. **FLAPS** – As required.
3. Trim – Set.
4. Power stabilized – Check 600 ft-lb torque minimum.
5. Takeoff power – Set.

8A-43. GO AROUND/MISSED APPROACH.

Accomplish the maneuver in accordance with the ATM utilizing the following procedure:

1. **POWER** – As required.
2. **FLAPS –** Retract to **APPROACH**.
3. **GEAR** (Positive climb) – **UP**.
4. **FLAPS** (105 KIAS) – **UP**.
5. **LANDING/TAXI LIGHTS** – **OFF**.
6. Climb power – Set.
7. **YD** – As required.
8. **BRAKE DEICE** – **OFF**.

8A-44. AFTER LANDING.

Complete the following procedures after the landing rollout is complete and normal taxi speed is attained:

1. **CONDITION** levers – As required.
2. **AUTO IGNITION** – **OFF**.
3. **ICE PROTECTION** switches – **OFF**.
4. **FLAPS** – **UP**.
5. **XPNDR** – As required.
6. Radar – As required.
7. Lights – As required.
   a. **WHITE ANTI-COLLISION** lights – **OFF**.
   b. **RECOG – OFF**.
   c. **LANDING/TAXI LIGHTS** – As required.
   d. **ICE VANES** – As required.

8A-45. ENGINE SHUTDOWN.

NOTE

To prevent sustained loads on rudder shock links, the aircraft should be parked with the nose gear centered.

1. **BRAKE DEICE – OFF**.
2. Parking brake – Set.
3. **LANDING/TAXI** lights – **OFF**.
4. **EFIS POWER** switches – **OFF**.
5. **INVERTER** – **OFF**.
6. **AUTOFEATHER** switch – **OFF**.
7. **CABIN TEMP MODE** – **OFF**.
8. **VENT** and **AFT VENT BLOWER** – **AUTO/OFF**.
9. **BATT** condition – Check. Battery charge light should be extinguished. If it is illuminated, turn the battery switch **OFF** momentarily and note loadmeter reading. Turn the battery switch **ON** and wait approximately 90 seconds, then turn the battery switch **OFF** and note loadmeter reading. Battery condition is unsatisfactory if the battery charge light remains illuminated and charge current fails to decrease between checks.
10. **ICE VANES** – As required.
11. **ITT** – Check. Must be 750° or below for 1 minute prior to shutdown.

CAUTION

Monitor ITT during shutdown. If sustained combustion is observed, proceed immediately to Abort Start procedure, Paragraph 8A-24.

12. **CONDITION** levers – **FUEL CUTOFF**.
13. **PROP** levers – **FEATHER**.

WARNING

Do not turn off exterior lights until propeller rotation has stopped.

14. **AVIONICS MASTER PWR – OFF**.
15. **MASTER PANEL LIGHTS – OFF**.
16. Exterior lights – **OFF**.

NOTE

Wait until gas generator speed of both engines drops below 10% prior to turning off the MASTER SWITCH.

17. **MASTER SWITCH – OFF**.
18. Oxygen system – **OFF**.
19. Chocks – As required.
20. Parking brake – As required.
21. Flight controls – As required.

8A-46. BEFORE LEAVING AIRCRAFT.

1. Wheel chocks – As required.

NOTE

Brakes should be released after chocks are in place (ramp conditions permitting).

2. Parking brake – As required.
3. Flight controls – Locked.
4. **OVERHEAD FLOOD** lights – **OFF**.
5. **STANDBY PUMPS** – **OFF**.
6. **MAP** lights – **OFF**.
7. Windows – As required.
8. Emergency exit lock – As required.
9. Galley power switches – **OFF**.
10. Aft cabin light – **OFF**.
11. Door light – **OFF**.

CAUTION

If strong winds are anticipated while the aircraft is unattended, the propellers shall be secured to prevent windmilling with zero engine oil pressure.

12. Walk-around inspection – Complete. Conduct a thorough walk-around inspection, checking for damage, fluid leaks, and levels. Check that covers, tiedowns, restraints, and chocks are installed as required.

13. Aircraft forms – Complete. In addition to established requirements for reporting any system defects, or unusual and excessive operation such as hard landings, etc., the flight crew will also make entries on DA Form 2408-13-1 to indicate when limits in the Operator's Manual have been exceeded.

14. Aircraft secured – Check. Lock cabin door as required.

Section III. INSTRUMENT FLIGHT

8A-47. GENERAL.

This aircraft is qualified for operation in instrument flight meteorological conditions. Flight handling, stability characteristics, and range are the same during instrument flight conditions as when under visual flight conditions.

8A-48. INSTRUMENT FLIGHT PROCEDURES.

Refer to FM 1-240, FM 1-230, FLIP, AR 95-1, TC 1-218, FAR 91 (subparts A and B), applicable foreign government regulations, and procedures described in this manual. Accomplish all instrument flight tasks in accordance with the appropriate ATM.

Section IV. FLIGHT CHARACTERISTICS

8A-49. STALLS.

A pre-stall warning in the form of very light buffeting can be felt when a stall is approached. A mechanical warning is also provided by a warning horn. The warning horn starts to alarm approximately 5 to 10 knots above stall speed with the aircraft in any configuration. If correct stall recovery technique is used, little altitude will be lost during the stall recovery. For the purpose of this section, the term "power-on" means that both engines and propellers are operating normally and are responsive to pilot control. The term "power-off" means that both engines are operating at idle power. Landing gear position has no effect on stall speed. During practice, enter power-off stalls from normal glides. Enter power-on stalls by smoothly increasing pitch attitude to a climb attitude (do not exceed 20°), and hold that attitude until the stall occurs.

a. Power-On Stalls. The power on stall attitude is steep and, unless this high pitch attitude is maintained, the aircraft will generally "settle" or "mush" instead of stall. It is difficult to stall the aircraft inadvertently in any normal maneuver. A light buffet precedes most stalls, and the first indication of approaching stall is generally a decrease in control effectiveness, accompanied by a stall warning horn. The stall itself is characterized by a rolling tendency if the aircraft is allowed to yaw. The proper use of rudder will minimize the tendency to roll. A slight pitching tendency will develop if the aircraft is held in the stall, resulting in the nose dropping sharply, then pitching up toward the horizon; this cycle is repeated until recovery is made. Control is regained very quickly with little altitude loss, providing the nose is not lowered excessively. Begin recovery with forward movement of the control wheel and a gradual return to level flight. The roll tendency caused by yaw is more pronounced in power-on stalls, as is the pitching tendency. However, both are easily controlled after the initial entry. Power-on stall characteristics are not greatly affected by flap position, except that stalling speed is reduced in proportion to flap extension.

b. Power-Off Stalls. The roll tendency is considerably less pronounced in power-off stalls (in any configuration), and is more easily prevented or corrected by adequate rudder and aileron control, respectively. The nose will generally drop straight through with some tendency to pitch up again if recovery is not made immediately. With flaps down, there is little or no roll tendency and stalling speed is much slower than with flaps up. The Stall Speeds chart shows the indicated power-off stall speeds with aircraft in various configurations. Refer to Figure 8A-3. Altitude loss during a full stall may be as much as 1,000 feet.

c. Accelerated Stalls. The aircraft gives noticeable stall warning in the form of buffeting before the stall occurs. The stall warning and buffet can be demonstrated in turns by applying excessive back pressure on the control wheel.

8A-50. SPINS.

Intentional spins are prohibited. If a spin is inadvertently entered, use the following recovery procedure. The first three actions should be performed as simultaneously as possible:

NOTE

Spin demonstrations have not been conducted. The recovery technique is based on the best available information.

1. **POWER** levers – **IDLE**.
2. Apply full rudder opposite direction of spin rotation.
3. Simultaneously with rudder application, push the control wheel forward and neutralize ailerons.
4. When rotation stops, neutralize rudder.

CAUTION

Do not pull out of the resulting dive too abruptly. This could cause excessive wing loads and possibly a secondary stall.

5. Pull out of dive by exerting a smooth, steady back pressure on control wheel, avoiding an accelerated stall and excessive aircraft stresses.

8A-51. DIVING.

Maximum airspeed (red line) V_{mo}/M_{mo} is 259 KIAS or 0.52 Mach. Flight characteristics are conventional throughout a dive maneuver. However, caution should be used if rough air is encountered after maximum allowable dive speed has been reached. Dive recovery should be very gentle to avoid excessive aircraft stresses.

8A-52. MANEUVERING FLIGHT.

Maneuvering speed (V_a) at which full abrupt control inputs can be applied without exceeding the design load factor of the aircraft is shown in Chapter 5. The data is based on 12,500 pounds and there are no restrictions below this weight. There are no unusual characteristics during accelerated flight.

8A-53. FLIGHT CONTROLS.

The aircraft is stable under all normal flight conditions. Aileron, elevator, rudder, and trim tab controls function effectively throughout all normal flight conditions. Elevator control forces are relatively light in the extreme aft Center of Gravity (CG) condition, progressing to moderately high with CG at the forward limit. Extending and retracting the landing gear causes only slight changes in control pressure. Control pressures resulting from changing power settings or repositioning the flaps are not excessive in the landing configuration at the most forward CG. The minimum speed at which the aircraft can be fully trimmed is 92 KIAS (gear and flaps down, propellers at high RPM). Control forces produced by changes in speed, power setting, flap position and landing gear position are light and can be overcome with one hand on the control wheel. Trim tabs permit the pilot to reduce control forces to zero. During single-engine operation, the rudder boost system aids in relieving the relatively high rudder pressures resulting from the large asymmetry in power.

8A-54. LEVEL FLIGHT CHARACTERISTICS.

All flight characteristics are conventional throughout the level flight speed range.

Section V. ADVERSE ENVIRONMENTAL CONDITIONS

8A-55. INTRODUCTION.

The purpose of this section is to inform the pilot of the special precautions and procedures to be followed during the various weather conditions that may be encountered in flight. This section is primarily narrative; only those checklists that cover specific procedures characteristic of weather operations are included. The checklist in Section II provides for adverse environmental operations.

8A-56. COLD WEATHER OPERATIONS.

Operational difficulties may be encountered during extremely cold weather, unless proper steps are taken prior to or immediately after flight. All personnel should understand and be fully aware of the necessary procedures and precautions involved.

CAUTION

For ground operations conducive to ice accumulation on landing gear structure, use undiluted defrosting fluid on brakes and tires to reduce the tendency of ice accumulation during taxi, takeoff, and subsequent landing.

STALL SPEEDS-POWER IDLE

NOTES:

1. MAXIMUM ALTITUDE LOSS DURING A NORMAL STALL RECOVERY IS APPROXIMATELY 1000 FEET.
2. MAXIMUM NOSE DOWN PITCH ATTITUDE AND ALTITUDE LOSS DURING RECOVERY FROM ONE ENGINE INOPERATIVE STALLS PER FAR 23.205 ARE APPROXIMATELY 20° AND 850 FEET RESPECTIVELY.
3. A NORMAL STALL RECOVERY TECHNIQUE MAY BE USED. THE BEST PROCEDURE IS A BRISK FORWARD WHEEL MOVEMENT TO A NOSE DOWN ATTITUDE. LEVEL THE AIRPLANE AFTER AIRSPEED HAS INCREASED APPROXIMATELY 25 KNOTS ABOVE STALL.

EXAMPLE:

WEIGHT .... 11,700 LBS
FLAPS .... APPROACH
ANGLE OF BANK .... 30°

STALL SPEED .... 95 KTS CAS
90 KTS IAS

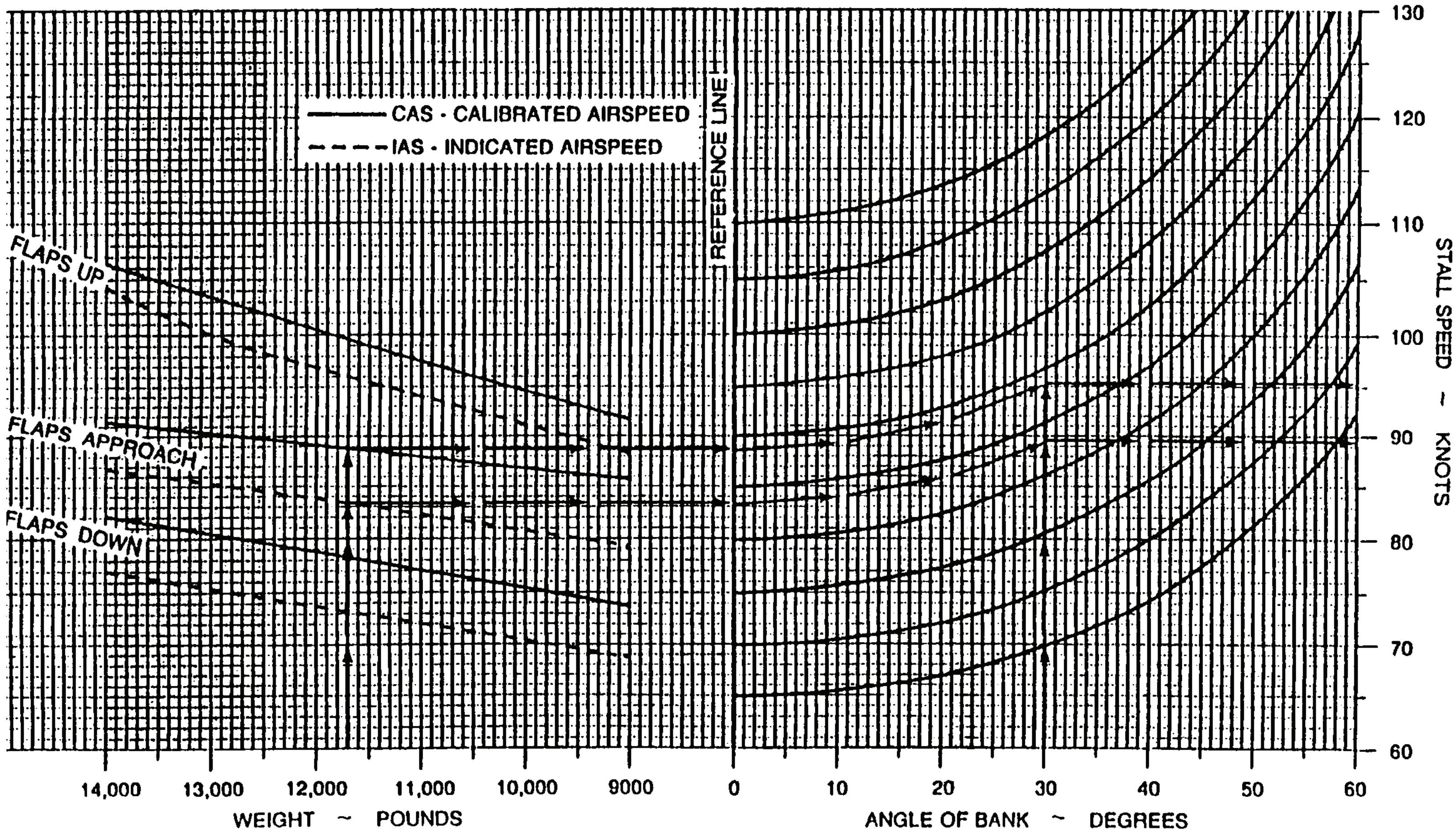


Figure 8A-3. Stall Speeds – Power Idle

a. Preparation for Flight. Accumulations of snow, ice, or frost on aircraft surfaces will adversely affect takeoff distance, climb performance, and stall speed to a dangerous degree. Such accumulations must be removed before flight. In addition to the normal exterior checks, following the removal of ice, snow, or frost, inspect wing and empennage surfaces to verify that these surfaces remain sufficiently cleared. Also, move all control surfaces to confirm full freedom of movement. Assure that tires are not frozen to wheel chocks or to the ground. Use ground heaters, anti-ice solution, or brake deice to free frozen tires. When heat is applied to release tires, the temperature should not exceed 71 °C (160 °F). Refer to Chapter 2 for anti-icing, deicing, and defrosting treatment.

b. Engine Starting. When starting engines on ramps covered with ice, propeller levers should be in the **FEATHER** position to prevent the tires from sliding. To prevent exceeding torque limits when advancing condition levers to **HIGH IDLE** during the starting procedure, place the power lever in **BETA** and the propeller lever in **HIGH RPM** before advancing the condition lever to **HIGH IDLE**.

c. Before Taxi and Engine Runup. Procedures are the same as those outlined in Section II.

d. Taxiing. Whenever possible, taxiing in deep snow, light-weight dry snow, or slush should be avoided, particularly in colder OAT conditions. If it is necessary to taxi through snow or slush, do not set the parking brake when stopped. If possible, do not park the aircraft in snow or slush deep enough to reach the brake assemblies. Chocks or sandbags should be used to prevent the aircraft from rolling while parked. Before attempting to taxi, activate the brake deice system, insuring that the bleed air valves are open and that the condition levers are in **HIGH IDLE**. An outside observer should visually check wheel rotation to ensure brake assemblies have been deiced. The condition levers may be returned to **LOW IDLE** as soon as the brakes are free of ice.

WARNING

If the possibility of ice accumulation on the horizontal stabilizer or elevator exists, do not attempt takeoff.

e. Before Takeoff. If icing conditions are expected, activate all anti-ice systems before takeoff, allowing sufficient time for the equipment to become effective.

NOTE

Following takeoff from runways covered with snow or slush, consideration should be given to operating the landing gear through several complete cycles (within limits) to dislodge ice accumulated from the spray of slush and water and to prevent gear freezing in the retracted position.

f. Takeoff. Takeoff procedures for cold weather operations are the same as for normal takeoff. Taking off with temperature at or below freezing, with water, slush, or snow on the runway, can cause ice to accumulate on the landing gear and can throw ice into the wheel well areas. Such takeoffs shall be made with brake deice on and with the ice vanes extended to preclude the possibility of ice build-up on engine air inlets. Monitor oil temperature to ensure operation within limits. Before flight into icing conditions, the pilot's and copilot's **WSHLD ANTI-ICE** switches should be set at **NORMAL** position.

g. During Flight.

(1) After takeoff from a runway covered with snow or slush, it may be advisable to leave brake deice on to dislodge ice accumulated from the spray of slush or water. Monitor **BRAKE DEICE ON** annunciator for automatic termination of system operation and then turn the switch off. During flight, trim tabs and controls should also be exercised periodically to prevent freezing. Ensure that anti-icing systems are activated before entering icing conditions. Do not activate the surface deice system until ice has accumulated to 1/2 inch. The propeller deice system operates effectively as an anti-ice system and it may be operated continuously in flight. If propeller imbalance due to ice does occur, it may be relieved by increasing RPM briefly, then returning to desired setting.

(2) Ice vanes must be extended when operating in visible moisture or when freedom from visible moisture cannot be assured, at +5 °C OAT or less. Ice vanes are designed as an anti-ice system, not a deice system. After the engine air inlet screens are blocked, extending the ice vanes will not rectify the condition. Ice vanes should be retracted at +15 °C OAT and above to assure adequate engine oil cooling.

(3) Stalling airspeeds should be expected to increase when ice has accumulated on the aircraft causing distortion of the wing airfoil. For the same reason, stall warning devices are not accurate and should not be relied upon. Keep a comfortable margin of airspeed above the normal stall airspeed. Maintain a minimum of 140 knots during sustained icing

conditions to prevent ice accumulation on unprotected surfaces of the wing. In the event of windshield icing, reduce airspeed to 226 knots or below.

h. Descent. Use normal procedures in Section II. Brake deicing should be considered if moisture was encountered during previous ground operations or in flight, in icing conditions with gear extended.

i. Landing. Landing on an icy runway should be attempted only when absolutely necessary and should not be attempted unless the wind is within 10° of runway heading. Application of brakes without skidding the tires on ice is difficult. In order not to impair pilot visibility, reverse thrust should be used with caution when landing on a runway covered with snow or standing water. Use procedures in Section II for normal landing.

j. Engine Shutdown. Use normal procedures in Section II.

k. Before Leaving Aircraft. When the aircraft is parked outside on ice or in a fluctuating freeze-thaw temperature condition, the following procedures should be followed in addition to the normal procedures in Section II. After wheel chocks are in place, release the brakes to prevent freezing. Fill fuel tanks to minimize condensation, remove any accumulation of dirt and ice from the landing gear shock struts, and install protective covers to guard against possible collection of snow and ice.

8A-57. DESERT OPERATION AND HOT WEATHER OPERATION.

Dust, sand, and high temperatures encountered during desert operation can sharply reduce the operational life of the aircraft and its equipment. The abrasive qualities of dust and sand upon turbine blades and other moving parts of the aircraft and the destructive effect of heat upon the aircraft instruments will necessitate hours of maintenance if basic preventive measures are not followed. In flight, the hazards of dust and sand will be difficult to escape, since dust clouds over a desert may be found at altitudes up to 10,000 feet. During hot weather operations, the principal difficulties encountered are high turbine gas temperatures (ITT) during engine starting, overheating of brakes, and longer takeoff and landing rolls due to the higher density altitudes. In areas where high humidity is encountered, electrical equipment (such as communication equipment and instruments) will be subject to malfunction by corrosion, fungi, and moisture absorption by nonmetallic materials.

a. Preparation for Flight. Check the position of the aircraft in relation to other aircraft. Propeller sand blast can damage closely parked aircraft. Check that the landing gear shock struts are free of dust and sand. Check the instrument panel and general interior for dust and sand accumulation. Open main entrance door and cockpit vent storm windows to ventilate the aircraft.

CAUTION

N_1 speeds of 70% or higher may be required to keep oil temperatures within limits.

b. Engine Starting. Use normal procedures in Section II. Engine starting under conditions of high ambient temperatures may produce a higher than normal **ITT** during the start. The **ITT** should be closely monitored when the condition lever is moved to the **LOW IDLE** position. If overtemperature tendencies are encountered, the condition lever should be moved to **IDLE CUTOFF** position periodically during acceleration of gas generator **RPM (N_1)**. Be prepared to abort the start before temperature limitations are exceeded.

c. Before Taxi and Engine Runup. Use normal procedures in Section II. To minimize the possibility of damage to the engines during dusty/sandy conditions, activate ice vanes and monitor engine oil temperatures. Retract the vanes if temperatures approach the temp limits.

d. Taxiing. Use normal procedures in Section II. When practical, avoid taxiing over sandy terrain to minimize propeller damage and engine deterioration that results from impingement of sand and gravel. During hot weather operation, use minimum braking action to prevent brake overheating.

e. Takeoff. Use normal procedures in Section II. Avoid taking off in the wake of another aircraft if the runway surface is sandy or dusty.

f. During Flight. Use normal procedures in Section II.

g. Descent. Use normal procedures in Section II.

h. Landing. Use normal procedures in Section II.

i. Engine Shutdown. Use normal procedures in Section II.

WARNING

If fuel tanks are completely filled during hot weather, fuel expansion may cause overflow, creating a fire hazard.

j. Before Leaving Aircraft. Use normal procedures in Section II. Take extreme care to prevent sand or dust from entering the fuel and oil system during servicing. During hot weather, release the brakes immediately after installing wheel chocks to prevent brake disc warpage.

8A-58. TURBULENCE AND THUNDERSTORM OPERATION.

CAUTION

Due to the comparatively light wing loading, control in severe turbulence and thunderstorms is critical. Since turbulence imposes heavy loads on the aircraft structure, make all necessary changes in aircraft attitude with the least amount of control pressures to avoid excessive loads on the aircraft structure.

Thunderstorms and areas of severe turbulence should be avoided. If such areas are to be penetrated, it will be necessary to counter rapid changes in attitude and accept major indicated altitude variations. Penetration should be at an altitude which provides adequate maneuvering margins as a loss or gain of several thousand feet of altitude may be expected. The recommended penetration speed in severe turbulence is 170 KIAS. Pitch attitude and constant power settings are vital to proper flight technique. Establish recommended penetration speed and proper attitude prior to entering turbulent air to minimize most difficulties. False indications by the pressure instruments due to barometric pressure variations within the storm make the instruments unreliable. Maintaining a pre-established attitude will result in a fairly constant airspeed. Turn cockpit and cabin lights on to minimize the blinding effects of lightning. Do not use autopilot altitude hold. Maintain constant power settings and pitch attitude regardless of airspeed or altitude indications. Concentrate on maintaining a level attitude by reference to the flight director/attitude indicator. Maintain original heading. Make no turns unless absolutely necessary.

8A-59. ICE AND RAIN (TYPICAL).

WARNING

While in icing conditions, if there is an unexplained 30% increase of torque needed to maintain airspeed in level flight, a cumulative total of 2 or more inches of ice accumulation on the wing, an unexplained decrease of 15 KIAS, or an unexplained deviation between pilot's and copilot's airspeed indicators, the icing environment should be exited as soon as practicable. Ice accumulation on the pitot tube assemblies could cause a complete loss of airspeed indication.

The following conditions indicate a possible accumulation of ice on the pilot tube assemblies and unprotected aircraft surfaces. If any of the following conditions are observed, the icing environment should be exited as soon as practicable:

1. Total ice accumulation of 2 inches or more on the wing surfaces. Determination of ice thickness can be accomplished by summing the estimated ice thickness on the wing prior to each pneumatic boot deice cycle (e.g., four cycles of minimum recommended 1/2 inch accumulation).

2. A 30% increase in torque per engine required to maintain desired airspeed in level flight (not to exceed 85% torque) when operating at recommended holding/ loiter speed.

3. A decrease in indicated airspeed of 15 knots after entering the icing condition (not slower than 1.4 times the power off stall speed) if maintaining original power setting in level flight. This can be determined by comparing pre-icing condition entry speed to the indicated speed after a surface deice cycle is completed.

4. Any variations from normal indicated airspeed between the pilot's and copilot's airspeed indicators.

a. Typical Icing. Icing occurs because of supercooled water vapor such as fog, clouds, or rain. The most severe icing occurs on aircraft surfaces in visible moisture or precipitation with a true outside air temperature between –5 °C and +1 °C. However, under some circumstances, dangerous icing conditions may be encountered with temperatures below –10 °C. The surface of the aircraft must be at a temperature of freezing or below for ice to stick. If severe icing conditions are encountered, ascend or descend to altitudes where these conditions do not prevail. If flight into icing conditions is unavoidable, proper use of aircraft anti-icing and deicing systems may minimize the problems encountered. Approximately 15 minutes prior to flight into temperature conditions which could produce frost or icing conditions, the pilot and copilot windshield anti-ice switches should be set at **NORMAL** or **HIGH** temperature position (after preheating) as necessary to eliminate windshield ice. Stalling airspeeds should be expected to increase when ice has accumulated on the aircraft causing distortion of the wing airfoil. For the same reason, stall warning devices are not accurate and should not be relied upon. Keep a comfortable margin of airspeed above the normal stall airspeed with ice on the aircraft. Maintain a minimum of 140 knots during sustained icing conditions to prevent ice accumulation on unprotected surfaces of the wing. In the event of windshield icing, reduce airspeed to 226 knots or below.

b. Rain. Rain presents no particular problems other than slippery runways, the potential for hydroplaning when there is standing water, restricted visibility, and occasional incorrect airspeed indications.

c. Taxiing. Extreme care must be exercised when taxiing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

d. Takeoff. Extreme care must be exercised during takeoff from ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

e. Climb. Keep aircraft attitude as flat as possible and climb with higher airspeed than usual, so that the lower surfaces of the aircraft will not be iced by flight at a high angle of attack.

f. Cruise Flight. Prevention of ice formation is far more effective and satisfactory than attempts to dislodge the ice after it has formed. If icing conditions are inadvertently encountered, turn on the anti-icing systems prior to the first sign of ice formation. Do not operate deicer boots continuously. Allow at least 1/2 inch of ice on the wing deicer boots before activating the deicer boots. Continued flight in severe icing conditions should not be attempted. If ice forms on the wing area aft of the deicer boots, climb or descend to an altitude where conditions are less severe.

g. Landing. Extreme care must be exercised when landing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid. Ice accumulation on the aircraft will result in higher stalling airspeeds due to the change in aerodynamic characteristics and increased weight of the aircraft due to ice buildup. Approach and landing airspeeds must be increased accordingly.

8A-60. ICING (SEVERE).

a. The following weather conditions may be conducive to severe in-flight icing:

1. Visible rain at temperatures below 0 °C ambient air temperature.

2. Droplets that splash or splatter on impact at temperatures below 0 °C ambient air temperature.

b. The following procedures for exiting a severe icing environment are applicable to all flight phases from takeoff to landing:

1. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as –18 °C, increased vigilance is warranted at temperatures around freezing with visible moisture present.

2. Upon observing the visual cues specified in the limitations section of this manual for the identification of severe icing conditions, Paragraph 5-35, accomplish the following:

   a. Immediately request priority handling from air traffic control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the aircraft has been certified.

   b. Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.

   c. Do not engage the autopilot.

   d. If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.

   e. If an unusual roll response or uncommanded roll control movement is observed reduce the angle-of-attack.

f. Do not extend flaps during extended operation in icing conditions. Flap extension may induce a tail plane stall. Also, operations with flaps extended can result in a reduced angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.

g. If the flaps are extended, do not retract them or extend them further until the airframe is clear of ice.

h. Report these weather conditions to air traffic control.

Section VI. CREW DUTIES.

★8A-61. CREW/PASSENGER BRIEFING.

The following guide should be used in accomplishing the required passenger briefings. Items that do not pertain to a specific mission may be omitted.

1. Crew introduction.
2. Equipment.
   - a. Personnel, to include ID tags.
   - b. Professional (medical equipment, etc.).
   - c. Survival.
3. Flight data.
   - a. Route.
   - b. Altitude.
   - c. Time en route.
   - d. Weather.
4. Normal procedures.
   - a. Entry and exit of aircraft.
   - b. Seating and seat position.
   - c. Seat belts.
   - d. Movement in aircraft.
   - e. Internal communications.
   - f. Operation of electronic devices.
   - g. Security of equipment.
   - h. Smoking.
   - i. Oxygen.
   - j. Refueling.
   - k. Weapons and prohibited items.
   - l. Protective masks.
   - m. Toilet.
5. Emergency procedures.
   - a. Emergency exits.
   - b. Emergency equipment.
   - c. Emergency landing / ditching procedures.

★8A-62. DEPARTURE BRIEFING.

The following is a guide that should be used as applicable in accomplishing the required crew briefing prior to takeoff. However, if the crew has operated together previously (through flight) and the pilot is certain that the copilot understands all items of the briefing, the pilot may omit the briefing by stating, "Standard briefing" or abbreviate it when the briefing is called for during the Before Takeoff check, Paragraph 8A-31:

1. ATC clearance – Review.
   - a. Routing.
   - b. Initial altitude.
2. Departure Procedure (DP) – Review.
   - a. Named departure procedure.
   - b. Obstacle clearance departure procedure / noise abatement procedure.

c. VFR departure route.

3. Copilot duties – Review.

   a. Adjust takeoff power.

   b. Monitor engine instruments.

   c. Power check at 65 knots.

   d. Call out engine malfunctions.

   e. Tune/identify all Nav/comm radios.

   f. Make all radio calls.

   g. Adjust transponder and radar as required.

   h. At Line-Up through the After Takeoff checklist, operate the PF's Heading and Course selectors, and AP/YD controllers.

   i. Complete flight log during flight and note altitudes and headings.

   j. Note departure time.

   k. Retract gear and flaps as directed.

4. TOLD card – Review.

   a. Takeoff power.

   b. V_1/V_r.

   c. V_2 + 10 KIAS (climb to 1500 feet AGL).

   d. V_2/V_{yse}.

★ 8A-63. ARRIVAL BRIEFING.

The following is a guide that should be used as applicable in accomplishing the required crew briefing prior to landing. However, if the crew has operated together previously (through flight) and the pilot is certain that the copilot understands all items of the briefing, the pilot may omit the briefing by stating, "Standard Briefing" or abbreviate it when the briefing is called for during the Descent-Arrival check, Paragraph 8A-37.

1. Weather/altimeter setting.

2. Airfield/facilities – Review.

   a. Field elevation.

   b. Runway length.

   c. Runway condition.

3. Approach procedure – Review.

   a. Approach plan/profile.

   b. Altitude restrictions.

   c. Missed approach.

      (1) Point.

      (2) Time.

      (3) Intentions.

   d. Decision height or MDA.

   e. Lost communications.

4. Backup approach/frequencies.

5. Copilot duties – Review.

   a. Nav/comm set-up.

   b. Monitor altitude and airspeeds.

   c. Monitor approach.

   d. Call out visual/field in sight.

6. Landing performance data – Review.

   a. Approach speed.

   b. Runway required.

7. During the Final Approach, operate the PF's Heading and Course selectors, and AP/YD controllers.

8. Passenger briefing – As required.

CHAPTER 9
EMERGENCY PROCEDURES

Section I. AIRCRAFT SYSTEMS

9-1. AIRCRAFT SYSTEMS.

This section describes the aircraft systems emergencies that may reasonably be expected to occur and presents the procedures to be followed. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the Operator's and Crewmember's Checklist, TM 1-1510-225-CL. Emergency operation of avionics equipment is covered in the appropriate Chapter 3, Avionics, and is repeated in this section only if safety of flight is affected.

9-2. IMMEDIATE ACTION EMERGENCY CHECKS.

Immediate action emergency items are underlined for reference and shall be committed to memory.

NOTE

The urgency of certain emergencies requires immediate action by the crew. The most important single consideration is aircraft control. All procedures are subordinate to this requirement. Reset MASTER CAUTION/MASTER WARNING after each malfunction to allow systems to respond to subsequent malfunctions.

9-3. DEFINITION OF LANDING TERMS.

The term, "Land as soon as possible" is defined as landing at the nearest suitable landing area (e.g., open field) without delay. The primary consideration is to ensure the survival of the occupants.

The term, "Land as soon as practicable" is defined as landing at a suitable landing area. The primary consideration is the urgency of the emergency.

9-4. AFTER EMERGENCY ACTION.

After a malfunction has occurred, appropriate emergency actions have been taken, and the aircraft is on the ground, make an entry in the remarks section of DA Form 2408-13-1 describing the malfunction.

9-5. EMERGENCY EXITS AND EQUIPMENT.

Emergency exits and equipment are shown in Figure 9-1.

9-6. EMERGENCY ENTRANCE.

Entry can be made through the cabin emergency hatch. Refer to Figure 9-1. The hatch can be released by pulling on its flush-mounted, pull-out handle, placarded **EMERGENCY EXIT – PULL HANDLE TO RELEASE**. The hatch is of the non-hinged, plug type, which removes completely from the frame when the latches are released. After the latches are released, the hatch may be pushed into the aircraft.

9-7. ENGINE MALFUNCTION.

a. Flight Characteristics Under Partial Power Conditions. There are no unusual flight characteristics during single-engine operation as long as airspeed is maintained above minimum control speed (V_{mc}) and power-off stall speed. The capability of the aircraft to climb or maintain level flight depends on configuration, weight, altitude, and free air temperature. Performance and aircraft control will improve by feathering the propeller of the inoperative engine, retracting the landing gear and flaps, and establishing the appropriate airspeed.

b. Engine Malfunction During and After Takeoff. The action to be taken in the event of an engine malfunction during takeoff depends upon whether or not decision speed (V_1) has been attained. If an engine fails immediately after V_1 , the takeoff will be continued single-engine. The PNF may feather the propeller on the failed engine as directed by the PF.

c. Engine Malfunction Before V_1 (Abort). If an engine fails and the aircraft has not accelerated to recommended decision speed (V_1), retard **POWER** levers to **IDLE** and stop the aircraft.

1. **POWER – IDLE**.

2. Braking – As required.

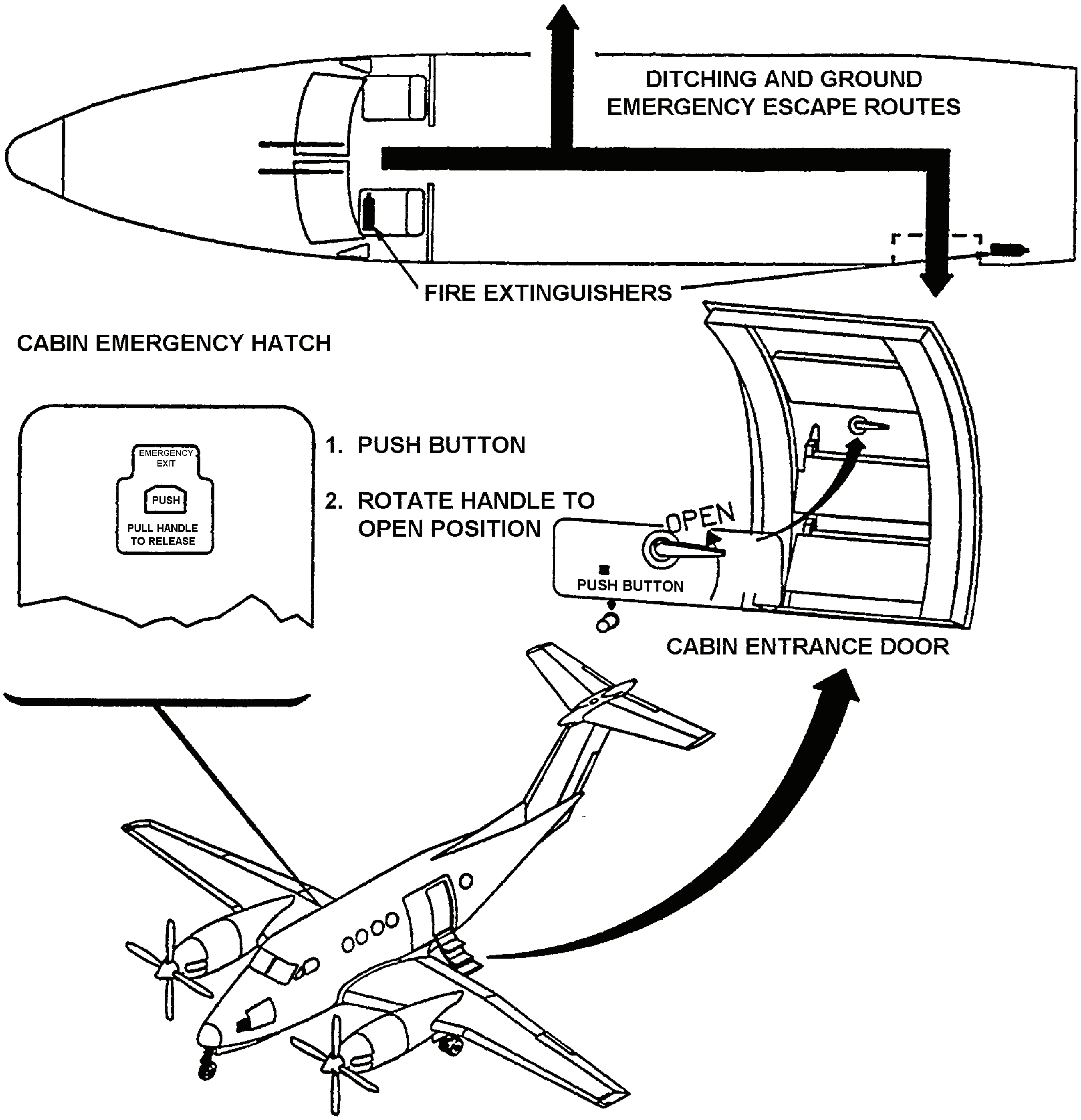

DITCHING AND GROUND
EMERGENCY ESCAPE ROUTES
FIRE EXTINGUISHERS
CABIN EMERGENCY HATCH
EMERGENCY EXIT
PUSH
PULL HANDLE TO RELEASE
1. PUSH BUTTON
2. ROTATE HANDLE TO OPEN POSITION
OPEN
PUSH BUTTON
CABIN ENTRANCE DOOR

Figure 9-1. Emergency Exits and Equipment

d. Engine Malfunction After V_1.

1. **GEAR** (positive climb) – **UP**.

2. **POWER** – As required.

3. **FLAPS** (105 KIAS) – **UP**.

IF THE PROP DID NOT FEATHER, PERFORM STEP 4. May be accomplished by PNF as directed by the PF.

4. **PROP** lever (dead engine) – **FEATHER**.

ONCE THE PROP IS FEATHERED, PERFORM STEPS 5 THROUGH 8.

O 5. **TCAS** – Set **TA**.

6. **LANDING/TAXI LIGHTS** – OFF.

7. **BRAKE DEICE** – **OFF**.

8. Engine cleanup – Perform.

NOTE

Holding 3° to 5° bank (1/4 to 1/2 ball width) toward the operating engine will assist in maintaining directional control and improving aircraft performance.

e. Engine Malfunction During Flight. If an engine malfunctions during flight, maintain control of the aircraft while maintaining heading, or turn as required. Add power as required to keep airspeed from decaying excessively and to maintain altitude. Identify the failed engine by feel (if holding rudder pressure to keep the aircraft from yawing, the rudder being pressed indicates the good engine) and engine instruments. Refer to Chapter 7 for One Engine Inoperative cruise information. If one engine malfunctions during flight, perform the following:

1. Autopilot/yaw damper – Disengage.

2. **POWER** – As required.

3. Dead engine – Identify.

4. **PROP** lever (dead engine) – **FEATHER**.

5. **GEAR** – As required.

6. **FLAPS** – As required.

O 7. **TCAS** – Set **TA**.

8. **POWER** – As required.

9. Engine cleanup – Perform, as time allows.

NOTE

Holding 3° to 5° bank (1/4 to 1/2 ball width) towards the operating engine will assist in maintaining directional control and improving aircraft performance.

f. Engine Malfunction During Final Approach. If an engine malfunctions during final approach, after Landing Check, the propeller should not be manually feathered unless time and altitude permit or conditions require it. Continue approach using the following procedure:

1. **POWER** – As required.

2. **GEAR** – **DN**.

g. Engine Malfunction (Second Engine). If the second engine fails, do not feather the propeller if an engine restart is to be attempted. Engine restart without starter assist cannot be accomplished with a feathered propeller, and the propeller will not unfeather without the engine operating. The airspeed to fly will depend upon whether or not a restart will be attempted, and whether or not the restart attempt will be accomplished with or without starter assist. If no restart is to be attempted, use maximum glide speed from Figure 9-2. Perform the following procedure if the second engine fails during cruise flight.

1. Airspeed – As required.

2. **PROP** lever – As required.

9-8. ENGINE SHUTDOWN IN FLIGHT.

If it becomes necessary to shut an engine down during flight, perform the following:

1. **POWER** lever – **IDLE**.

2. **PROP** lever – **FEATHER**.

3. **CONDITION** lever – **FUEL CUTOFF**.

4. Engine cleanup – Perform.

9-9. ENGINE CLEANUP.

The cleanup procedure to be used after engine malfunction, shutdown, or an unsuccessful restart is as follows:

1. **CONDITION** lever – **FUEL CUTOFF**.
2. **ENG AUTO IGNITION** switch – **OFF**.
3. **AUTOFEATHER** switch – **OFF**.
4. **GEN** switch – **OFF**.
5. **ENGINE ANTI-ICE/ICE VANE** – **ON/EXTEND**, inoperative engine.

9-10. ENGINE RESTART DURING FLIGHT (USING STARTER).

Engine restarts may be attempted at all altitudes. If a restart is attempted, perform the following:

CAUTION

The pilot should determine the reason for engine failure before attempting an engine restart during flight. Do not attempt an engine restart if N_1 indicates zero.

1. **CABIN TEMP MODE** switch – **OFF**.
2. Electrical load – Reduce to minimum.
3. Fuel **FIREWALL SHUTOFF VALVE – OPEN**.
4. **POWER** lever – **IDLE**.
5. **PROP** lever – **FEATHER**.
6. **CONDITION** lever – **FUEL CUTOFF**.
7. **ITT** (operating engine) – 700 ºC or less.
8. Engine – Start.
   a. **IGNITION AND ENGINE START** switch – **ON**.
   b. **CONDITION** lever – **LOW IDLE**.

   NOTE

   If a rise in ITT does not occur within 10 seconds after moving the CONDITION lever to LOW IDLE, abort the start.

   c. **ITT** – 1000 °C, 5 seconds maximum.

   NOTE

   If N_1 is below 12%, starting temperatures tend to be higher than normal. To preclude overtemperature (1000 °C or above) during engine acceleration to idle speed, periodically move the CONDITION lever into FUEL CUTOFF position as necessary.

   d. Oil pressure – Check.
   e. **IGNITION AND ENGINE START** switch – **OFF** at 50% N_1.
9. **GEN** switch – **RESET**, then **ON**.
10. Engine cleanup – Perform if engine restart is unsuccessful.
11. **CABIN TEMP MODE** switch – As required.
12. Electrical equipment – As required.
13. **ENG AUTO IGNITION** switch – **ARM**.
14. **PROP SYN** switch – As required.
15. **POWER** – As required.

9-11. ENGINE RESTART DURING FLIGHT (NOT USING STARTER).

A restart without starter assist may be accomplished provided airspeed is at or above 140 KIAS, altitude is below 20,000 feet, and the propeller is not feathered. If altitude permits, diving the aircraft will increase N_1 and assist in restart.

1. **CABIN TEMP MODE** switch – **OFF**.
2. Electrical load – Reduce to minimum.
3. **GEN** switch (affected engine) – **OFF**.
4. Fuel **FIREWALL SHUTOFF VALVE – OPEN**.
5. **POWER** lever – **IDLE**.
6. **PROP** lever – **HIGH RPM**.
7. **CONDITION** lever – **FUEL CUTOFF**.
8. Airspeed – 140 KIAS minimum.

9. Altitude – Below 20,000 feet.

10. **ENG AUTO IGNITION** Switch – **ARM**.

11. **CONDITION** lever – **LOW IDLE**.

NOTE

If a rise in ITT does not occur within 10 seconds after moving the CONDITION lever to LOW IDLE, abort the start.

12. **ITT** – 1000 ºC, 5 seconds maximum.

13. Oil pressure – Check.

14. **GEN** switch – **RESET**, then **ON**.

15. Engine cleanup – Perform if engine restart is unsuccessful.

16. **CABIN TEMP MODE** switch – As required.

17. Electrical equipment – As required.

18. Propellers – Synchronized.

19. **POWER** – As required.

NOTE

If N_1 is below 12%, starting temperatures tend to be higher than normal. To preclude over-temperature (1000ºC or above) during engine acceleration to idle speed, periodically move the CONDITION lever into FUEL CUTOFF position as necessary.

9-12. SINGLE-ENGINE DESCENT/ARRIVAL.

NOTE

Approximately 85% N_1, is required to maintain pressurization schedule.

Perform the following procedure prior to the descent for landing:

1. Cabin pressurization controller – Set.

2. **CABIN** signs – As required.

3. **ICE PROTECTION** switches – As required.

4. Altimeters – Set.

5. **RECOG** lights – On.

★ 6. Arrival briefing – Complete (refer to Chapter 8 Section VI).

9-13. SINGLE-ENGINE BEFORE LANDING.

1. **CABIN** signs switch – **NO SMOKE & FSB.**

2. **BRAKE DEICE** switch – **OFF**.

3. **ENGINE ANTI-ICE** R **/ICE VANE** T3 F3 – As required.

4. **PROP** lever – As required.

NOTE

During approach, propeller should be set at 2000 RPM.

5. **FLAPS** (below 200 KIAS) – **APPROACH**.

6. **GEAR** (below 181 KIAS) – **DN/**Confirm.

7. **LANDING/TAXI LIGHTS** – As required.

9-14. SINGLE-ENGINE LANDING CHECK.

NOTE

To ensure consistent reversing characteristics, the propeller control shall be in the HIGH RPM position.

Perform the following procedure during final approach to runway:

1. **AP & YD** – Disengage.

2. **GEAR DOWN** lights – Check.

3. **PROP** lever (operative engine) – **HIGH RPM**.

9-15. SINGLE-ENGINE GO-AROUND.

The decision to go around must be made as early as possible. Elevator forces at the start of the go-around are very high, and a considerable amount of rudder control will also be required at low airspeeds. Re-trim as required. If rudder application is insufficient, or applied too slowly, directional control cannot be maintained. If control difficulties are experienced, reduce power on the operating engine immediately. Ensure the aircraft will not touch the ground before retracting the landing gear. Retract the flaps only as safe airspeed permits. Maintain flaps in the APPROACH position until 105 KIAS, then retract to **UP**. Perform single-engine go-around as follows:

NOTE

Once flaps are fully extended, a single-engine go-around may not be possible when close to ground under conditions of high gross weights and/or high density altitude.

1. **POWER** – As required.
2. **FLAPS –** Retract to **APPROACH**.
3. **GEAR** (Positive climb) – **UP**.
4. **FLAPS** (105 KIAS) – **UP**.
5. **LANDING/TAXI LIGHTS** – **OFF**.
6. **POWER** – As required.
7. **YD**– As required.

9-16. MAXIMUM GLIDE.

In the event of failure of both engines, maximum glide distance can be obtained by feathering both propellers to reduce propeller drag and by maintaining the appropriate airspeed with the gear and flaps up. Figure 9-2 gives the approximate gliding distances in relation to altitude.

9-17. LANDING WITH TWO ENGINES INOPERATIVE.

Maintain best glide speed. Refer to Figure 9-2 for maximum glide distances. If sufficient altitude remains after reaching a suitable landing area, a circular pattern will provide best observation of surface conditions, wind velocity, and direction. When the condition of the terrain has been noted and landing area selected, set up a rectangular pattern. Extending **APPROACH** flaps and landing gear early in the pattern will give an indication of glide performance sooner and will allow more time to make adjustments for the added drag. Select a landing area of adequate size to accommodate the aircraft, preferably free of obstacles and smooth. Fly the base leg as necessary to control the point of touchdown. Plan to overshoot rather than undershoot, then use flaps as necessary to arrive at the selected landing point. Keep in mind that, with both propellers feathered, the normal tendency is to overshoot due to less drag. In the event a positive gear-down indication cannot be determined, and unless the surface of the landing area is hard and smooth, the landing should be made with the landing gear up. If landing on rough terrain, land in a tail-low attitude to keep the nacelles from digging in. If possible, land with flaps fully extended.

9-18. LOW OIL PRESSURE.

In the event of a low oil pressure indication, perform the following procedures as applicable:

1. **R** Torque – 49% maximum. Oil pressure less than 100 psi below 21,000 feet or less than 85 psi above 21,000 feet.
2. **T3** **F3** Torque – 1100 ft-lb maximum. Oil pressure less than 100 psi below 21,000 feet or less than 85 psi above 21,000 feet.
3. Oil Pressure Below 60 psi – Perform engine shutdown, or land as soon as practicable using minimum power to ensure safe arrival.

9-19. CHIP DETECT CAUTION LIGHT ILLUMINATED.

If the **L CHIP DETECT** or **R CHIP DETECT** caution annunciator illuminates, and safe single-engine flight can be maintained, perform engine shutdown.

9-20. DUCT OVERTEMP CAUTION LIGHT ILLUMINATED.

Ensure the cabin floor outlets are open and unobstructed, then perform the following steps in sequence until the annunciator is extinguished. Allow approximately 30 seconds after each adjustment for the system temperature to stabilize. The overtemperature condition is considered to be corrected at any point during the procedure that the light goes out.

1. **CABIN/COCKPIT AIR** control – In.
2. **CABIN TEMP MODE** switch – **AUTO**.
3. **CABIN TEMP** switch – Decrease.
4. **VENT BLOWER** switch – **HIGH**.
5. **CABIN TEMP MODE** switch – **MAN COOL**.
6. **CABIN TEMP** switch – Decrease (hold).

MAXIMUM GLIDE DISTANCE

STANDARD DAY (ISA)

ASSOCIATED CONDITIONS:
POWER .... BOTH ENGINES INOPERATIVE
PROPELLER .... FEATHERED
LANDING GEAR ..... UP
FLAPS .... UP (0%)
AIRSPEED .... IAS AS TABULATED
WIND .... ZERO KNOTS

EXAMPLE:
HEIGHT ABOVE TERRAIN .... 12,000 FT
WEIGHT .... 13,000 LB
MAXIMUM GLIDE DISTANCE ..... 28.3 NM
BEST GLIDE SPEED .... 125 KIAS

WEIGHT ~ POUNDS	BEST GLIDE SPEED ~ KNOTS
14,000	130
13,000	125
12,500	123
11,000	115
10,000	110
9,000	105

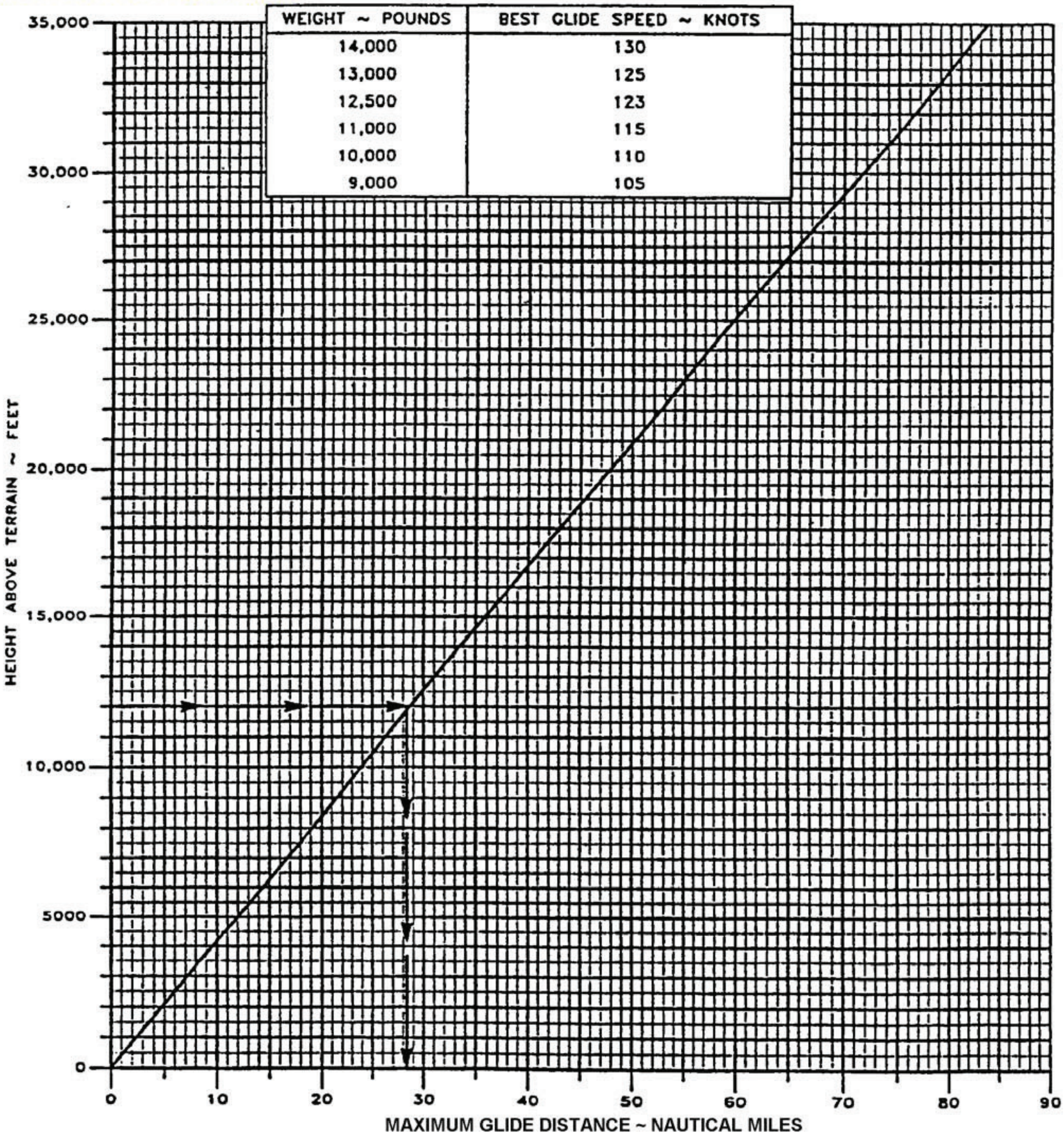


Figure 9-2. Maximum Glide Distance

7. **LEFT BLEED AIR VALVE** switch – **PNEU** & **ENVIR OFF**.

8. Light still illuminated (after 30 seconds) **LEFT BLEED AIR VALVE** switch – **OPEN**.

9. **RIGHT BLEED AIR VALVE** switch – **PNEU** & **ENVIR OFF**.

10. Light still illuminated (after 30 seconds) **RIGHT BLEED AIR VALVE** switch – **OPEN**.

NOTE

If the DUCT OVERTEMP light has not extinguished after completing the above procedure, the warning system has malfunctioned.

9-21. ENGINE ANTI-ICE/ICE VANE FAILURE (L or **R ENG ICE/FAIL** annunciator illuminated**.**

1. **ENGINE ANTI-ICE ACTUATOR** switch – **STANDBY**.

IF **ENG ICE FAIL** ANNUNCIATOR DOES NOT EXTINGUISH:

2. Icing conditions – Exit. Assume engine anti-ice is still on for performance calculations.

9-22. ENGINE BLEED AIR SYSTEM MALFUNCTION.

a. L or R BL AIR FAIL Annunciator Illuminated. Steady illumination of the warning annunciator in flight indicates a possible ruptured bleed air line aft of the engine firewall. The annunciator will remain illuminated for the remainder of flight. Perform the following:

NOTE

BL AIR FAIL annunciators may momentarily illuminate during simultaneous surface deice and brake deice operation at low N_1 speed.

1. **BRAKE DEICE** switch – **OFF**.

2. **ITT** and **TORQUE** – Monitor (note readings).

3. **BLEED AIR VALVE** switch – **OFF**.

NOTE

Brake deice (on the affected side) and rudder boost will not be available with bleed air valve switch off.

4. Cabin pressurization – Check.

b. Excessive Differential Pressure. If cabin differential pressure exceeds 6.6 psi, perform the following:

1. Cabin pressurization controller – Select higher setting.

IF CONDITION PERSISTS:

2. Oxygen (crew and passengers) – As required.

3. **LEFT BLEED AIR VALVE** switch – **ENVIR OFF**.

IF CONDITION STILL PERSISTS:

4. **RIGHT BLEED AIR VALVE** switch – **ENVIR OFF**.

5. Descend – As required.

IF CONDITION STILL PERSISTS:

6. Oxygen masks – **100%** and on.

7. **CABIN PRESS** switch – **DUMP**.

8. **BLEED AIR VALVE** switches – **OPEN** (if cabin heating is required).

9-23. LOSS OF PRESSURIZATION (ABOVE 10,000 FEET).

If cabin pressurization is lost when operating above 10,000 feet or the **ALT WARN** warning annunciator illuminates, perform the following:

1. Crew oxygen masks – **100%** and on.

2. Passenger oxygen – **ON**. Check to ensure all passengers have oxygen masks on and are receiving supplemental oxygen if required.

9-24. DOOR UNLOCKED/CABIN DOOR WARNING ANNUNCIATOR ILLUMINATED.

Remain clear of cabin door and perform the following:

1. **CABIN** signs switch – **NO SMOKE & FSB**.

2. **BLEED AIR VALVE** switches – **ENVIR OFF**.

3. Altitude – Descend below 14,000 feet as soon as practicable.

4. Oxygen – As required.

9-25. PROPELLER FAILURE, OVER 2120 RPM.

If an overspeed condition occurs that cannot be controlled with the **PROP** lever or by reducing power, perform the following:

1. **POWER** lever (affected engine) – **IDLE**.

2. **PROP** lever (Affected Engine) – **FEATHER**.

3. **CONDITION** lever – As required.

4. Engine cleanup – As required.

9-26. FIRE.

The safety of aircraft occupants is the primary consideration when a fire occurs, therefore, it is imperative that every effort be made by the flight crew to put the fire out. On the ground it is essential that the engines be shut down, crew and passengers evacuated, and fire fighting begun immediately. If the aircraft is airborne when a fire occurs, the most important single action that can be taken by the pilot is to land safely as soon as possible.

a. Engine Fire. The following procedures shall be performed in case of engine fire.

(1) Engine/Nacelle Fire During Start or Ground Operations. If engine/nacelle fire is identified during start or ground operation, perform the following:

1. **PROP** levers – **FEATHER**.

2. **CONDITION** levers – **FUEL CUT-OFF**.

3. Fuel **FIREWALL SHUTOFF VALVES – CLOSED**.

CAUTION

If fire extinguisher has been used to extinguish an engine fire, do not attempt to restart until maintenance personnel have inspected the aircraft and released it for flight.

O 4. **PUSH TO EXTINGUISH** switch – Push.

5. **MASTER SWITCH – OFF**.

(2) Engine Fire in Flight (Identified). If an engine fire is confirmed in flight, perform the following:

CAUTION

Due to the possibilities of fire warning malfunctions, the fire should be visually identified before the engine is secured and the extinguisher actuated.

1. **POWER** lever – **IDLE**.

2. **PROP** lever – **FEATHER**.

3. **CONDITION** lever – **FUEL CUT – OFF**.

4. Fuel **FIREWALL SHUTOFF VALVE – CLOSED**.

O 5. **PUSH TO EXTINGUISH** switch – Push as required.

6. Engine cleanup – Perform.

7. Land as soon as practicable.

b. Fuselage Fire. If a fuselage fire occurs, perform the following:

WARNING

The extinguishing agent (bromochloro-difluoromethane) in the fire extinguisher can produce toxic effects if inhaled.

1. Fight the fire.

2. Land as soon as possible.

c. Wing Fire. There is little that can be done to control a wing fire except to shut off fuel and electrical systems that may be contributing to the fire, or which could aggravate it. Diving and slipping the aircraft away from the burning wing may help. If a wing fire occurs, perform the following:

1. Perform engine shutdown on affected side.
2. Land as soon as possible.

d. Electrical Fire. Upon noting the existence or indications of an electrical fire, turn off all affected electrical circuits, if known. If electrical fire source is unknown, perform the following:

1. Crew oxygen masks – As required.
2. Passenger oxygen – As required.
3. **MASTER SWITCH** – **OFF** (visual conditions only).
4. All nonessential electrical equipment – Off.

NOTE

With the loss of DC electrical power, the aircraft will de-pressurize. All engine instruments, with the exception of PROP RPM, N_1 RPM, and ITT gauges, will be inoperative.

5. **BATT** switch – **ON**.
6. **GEN** switches (individually) – **RESET**, then **ON**.
7. Circuit breakers – Check for indication of defective circuit.

CAUTION

As each electrical switch is returned to ON, note loadmeter reading and check for evidence of fire.

8. Essential electrical equipment – On (individually until fire source is isolated).
9. Land as soon as practicable.

e. Smoke and Fume Elimination. To eliminate smoke and fumes from the aircraft, perform the following:

1. Crew oxygen masks – **100%** and on.
2. Passenger oxygen – **ON**.
3. **BLEED AIR VALVE** switches – **PNEU** & **ENVIR OFF**.
4. **VENT BLOWER** switch – **AUTO**.
5. **AFT BLOWER** switch – **OFF**.
6. **CABIN TEMP MODE** switch – **OFF**.
7. If smoke and fumes are not eliminated: **CABIN PRESS** switch – **DUMP**.

NOTE R

Opening storm window, after depressurizing, will facilitate smoke and fume removal.

8. Passenger oxygen masks – Check. Confirm that all passengers are receiving supplemental oxygen.
9. Engine Oil Pressure – Monitor.

9-27. FUEL SYSTEM.

a. FUEL PRESS Warning Light Illuminated. Illumination of the **L** or **R FUEL PRESS** warning light usually indicates failure of the respective engine-driven boost pump. Perform the following:

1. **STANDBY PUMP** switch – **ON**.
2. **FUEL PRESS** light out – Check.
3. **FUEL PRESS** light still illuminated – Record unboosted time.

b. NO TRANSFER Indicator Light Illuminated (Fuel Panel). Illumination of a **NO TRANSFER** indicator light with fuel remaining in the respective auxiliary fuel tank indicates a failure of that automatic fuel transfer system. Proceed as follows:

1. **AUX TRANSFER** switch (affected side) – **OVERRIDE**.
2. Auxiliary fuel quantity – Monitor.
3. **AUX TRANSFER** switch (after respective auxiliary fuel has completely transferred) – **AUTO**.

c. Nacelle Fuel Leak. If nacelle fuel leaks are evident, perform the following:

1. Perform engine shutdown.

2. Fuel **FIREWALL SHUTOFF VALVE** – **CLOSED**.

3. Land as soon as practicable.

d. Fuel Crossfeed. Fuel crossfeed is normally used only during single-engine operation. The fuel from the inoperative engine side may be used to supply the operative engine, by routing the fuel through the crossfeed system. During extended flights, this method of fuel usage will provide a more balanced lateral load condition in the aircraft. For fuel crossfeed, use the following procedure:

1. **AUX TRANSFER** switches – **AUTO**.

NOTE

With the fuel FIREWALL SHUTOFF VALVE CLOSED, fuel in the auxiliary tank for that side will not be available (usable) for crossfeed.

2. **STANDBY PUMPS** – **OFF**.

3. **CROSSFEED FLOW** – As required.

4. **FUEL CROSSFEED** annunciator illuminated – Check.

NOTE

With the Fuel FIREWALL SHUTOFF VALVE CLOSED, the FUEL PRESS annunciator will remain illuminated on the side supplying fuel.

5. **FUEL PRESS** annunciator extinguished – Check.

6. Fuel quantity – Monitor.

9-28. ELECTRICAL SYSTEM EMERGENCIES.

a. DC GEN Light Illuminated. Illumination of **L DC GEN** or **R DC GEN** caution light indicates failure of a generator or one of its associated circuits. If one generator system becomes inoperative, all nonessential electrical equipment should be used judiciously to avoid overloading the remaining generator. If both generators are shut off due to either generator system failure or engine failure, all nonessential equipment should be turned off to preserve battery power for extending the landing gear and flaps. When a **L DC GEN** or **R DC GEN** light illuminates, perform the following:

1. **GEN** switch – **OFF**, **RESET**, then **ON**.

IF THE GENERATOR DOES NOT RESET:

2. **GEN** switch – **OFF**.

3. Operating loadmeter – 100% maximum.

b. Both DC GEN Lights Illuminated.

1. All nonessential equipment – Off.

2. Land as soon as practicable.

O 3. Fuel may be manually transferred from ferry tanks using wobble pump installed in the fuel pump assembly.

c. Excessive Loadmeter indication (Over 100%). If either loadmeter indicates over 100%, perform the following:

1. **BATT** switch – **OFF** (monitor loadmeter).

IF LOADMETER STILL INDICATES ABOVE 100%:

2. Nonessential electrical equipment – Off.

IF LOADMETER INDICATES 100% OR BELOW:

3. **BATT** switch – **ON**.

d. INVERTER Warning Light Illuminated. Illumination of the **INVERTER** warning annunciator indicates that the selected inverter is inoperative. Perform the following:

1. Select the other inverter.

e. Circuit Breaker Tripped. If the circuit breaker is for a nonessential item, do not reset in flight. If the circuit breaker is for an essential item, the circuit breaker may be reset once. Perform the following:

1. Nonessential circuit – Do not reset in flight.

2. Essential circuit – Reset once. If it trips again, do not reset.

f. Bus Feeder Circuit Breaker Tripped (Fuel Panel Bus Feeders and Right Circuit Breaker Panel Bus Feeders).

1. A short is indicated, do not reset in flight.

NOTE

The items that may be inoperative can be determined from the electrical system schematic in Chapter 2, Systems.

g. BATTERY CHG Annunciator Illuminated During Ground Operations. The **BATTERY CHG** annunciator will illuminate after an engine start. If the annunciator does not extinguish within approximately 5 minutes, monitor the battery charge current using the following procedure:

1. One generator – **OFF**.
2. Voltmeter – Indicating 28 volts.
3. Momentarily turn the battery **OFF** – Note change in loadmeter indication.

NOTE

The change in loadmeter indication is the battery charge current and should be NO more than 2.5% (only perceivable needle movement). If the results are unsatisfactory, repeat the check until the charge current decreases to less than 2.5%.

h. BATTERY CHG Annunciator Illuminated In Flight. In-flight illumination of the **BATTERY CHG** annunciator indicates a possible battery malfunction. Use the following procedure:

1. **BATT** – **OFF**.
2. **BATTERY CHG** annunciator – Check. If extinguished, continue flight. If the light remains illuminated, land as soon as practicable.

i. Generator Overheat (T3/F3)

1. **GEN** – **OFF**.
2. Electrical load – Check.
3. Current limiters – Check.

j. Current Limiter Check.

1. If both **DC GEN** annunciators are illuminated – Individually press each volt/ loadmeter switch and observe voltage. If generator voltage is not seen on voltmeter, that current limiter has burned open.
2. If one **DC GEN** annunciator is illuminated – Press both volt/loadmeter switches and observe voltage. If generator voltage is not seen on the affected side, one or more current limiters have burned open. If battery voltage is not seen on the affected side, the current limiter for that side has burned open.

9-29. EMERGENCY DESCENT.

Emergency descent is a maximum effort in which damage to the aircraft must be considered secondary to getting the aircraft down. The following procedure assumes the structural integrity of the aircraft and smooth flight conditions. If structural integrity is in doubt, limit speed as much as possible, reduce rate of descent if necessary, and avoid high maneuvering loads. For emergency descent, perform the following:

1. <u>**POWER** levers – **IDLE**</u>.
2. <u>**PROP** levers – **HIGH RPM**</u>.
3. <u>**FLAPS** – **APPROACH**</u>.
4. <u>**GEAR** – **DN**</u>.
5. <u>Airspeed – 181 KIAS maximum</u>.

NOTE

Windshield defogging may be required.

9-30. LANDING EMERGENCIES.

WARNING

Structural damage may exist after landing with brake, tire, or landing gear malfunctions. Under no circumstances shall an attempt be made to inspect the aircraft until jacks have been installed.

NOTE

If the HYD FLUID LOW annunciator illuminates during flight, attempt to extend the landing gear normally upon reaching destination. If the landing gear fails to extend, follow the procedures for LANDING GEAR MANUAL EXTENSION.

a. Landing Gear Unsafe Indication. Should one or more of the landing gear fail to indicate a safe condition, the following steps should be taken before proceeding manually to extend the gear.

1. **LDG GEAR CONTROL** – Check **DN**.

2. **LANDING GEAR RELAY** and **GEAR IND** circuit breakers – Check in.

3. **GEAR DOWN** lights – Check illuminated.

IF INDICATOR REMAINS UNSAFE:

4. Landing gear manual extension – Perform.

b. Landing Gear Manual Extension.

1. Airspeed – Below 181 KIAS.

2. **LANDING GEAR RELAY** circuit breaker – Pull.

3. **LDG GEAR CONTROL** – **DN**.

CAUTION

If all three of the green GEAR DOWN lights do not illuminate, continue pumping until sufficient resistance is felt to ensure the gear is down and locked. DO NOT STOW THE MANUAL EXTENSION LEVER, LEAVE IT IN THE UP POSITION.

4. Manual extension lever – Unstow. Pump until the three green **GEAR DOWN** lights are illuminated and resistance is felt.

5. Manual extension lever – If three green **GEAR DOWN** lights are illuminated, stow the lever.

CAUTION

After a manual landing gear extension has been made due to a malfunction of the system, do not move any landing gear controls or reset any switches or circuit breakers until the cause of the malfunction has been corrected. The malfunction may be in the gear up circuit and the gear might retract on the ground.

c. Gear-up Landing (All Gear Up). Due to decreased drag with the gear up, there may be a tendency to overshoot the desired landing point. The center of gravity will be aft of the main wheels, allowing the aircraft to be landed with a minimum amount of structural damage to the aircraft provided the wings are kept level. It is recommended the fuel load be reduced and the landing made with the flaps fully extended. A hard surface runway should be utilized for the landing whenever possible. Landing on soft ground is not recommended, as sod has a tendency to roll up into chunks and damage the underside of the aircraft structure. When fuel load has been reduced, prepare for a gear up landing as follows:

1. Fuel load – Reduce.

2. Personnel emergency briefing – Complete.

3. Loose equipment – Stow/secure.

4. **BLEED AIR VALVES** – **ENVIR OFF** (below 10,000 feet).

5. **CABIN PRESS** switch – **DUMP**.

WARNING

Prior to removing the emergency exit hatch, slow to a safe airspeed (approximately 160 KIAS or below) and ensure passengers are seated with seat belts fastened and all loose equipment secured.

6. Emergency exit hatch – Remove and stow.

7. Seat belts and harnesses – Fasten.

8. Gear manual extension handle – Stow.

9. **LDG GEAR CONTROL** – **UP**.

10. **LANDING GEAR RELAY** circuit breaker – Pull.

11. **LANDING GEAR WARN** horn circuit breaker – Pull.

12. **GPAAS/GPWS POWER** circuit breaker – Pull.

13. Nonessential electrical equipment – Off.

NOTE

Fly a normal approach to touchdown. Avoid touching down in a nose-high attitude.

14. **FLAPS** – As required (**DOWN** is recommended for landing).

15. **POWER** levers – **IDLE** when landing on the desired touchdown area is assured.

16. **CONDITION** levers – **FUEL CUTOFF**.

17. Fuel **FIREWALL SHUTOFF VALVES** – **CLOSED**.

18. **MASTER SWITCH** – **OFF**.

d. Landing With Nose Gear Unsafe. If the **LDG GEAR CONTROL** warning light is illuminated and the **NOSE GEAR DOWN** light shows an unsafe condition, try to determine the position of the gear. This may be accomplished by a tower flyby or any other means available.

CAUTION

Do not attempt a MAIN GEAR DOWN, NOSE GEAR UP landing on a grass/sod runway, unprepared runway, or areas adjacent to the runway.

1. Fuel load – Reduce.

2. Crew and passenger briefing – Complete.

3. Loose equipment – Stow/secure.

4. **BLEED AIR VALVES** – **ENVIR OFF** (below 10,000 feet).

5. Cabin pressure switch – **DUMP** (after cabin has depressurized).

WARNING

Prior to removing the emergency exit hatch, slow to a safe airspeed (approximately 160 KIAS or below) and ensure passengers are seated with seat belts fastened and all loose equipment secured.

6. Emergency exit hatch – Remove and secure.

7. Seat belts and harnesses – Fasten.

8. Extension handle – Stow.

9. **LDG GEAR CONTROL** – **DN**.

10. **LANDING GEAR RELAY** circuit breaker – Pull.

11. **LANDING GEAR WARN** horn circuit breaker – Pull.

WARNING

Make a normal approach but hold the nose up as long as possible after touchdown, then ease the nose gently to the runway prior to loss of elevator control. Preventing a sudden drop will minimize structural damage. Use rudder and brakes for directional control. Do not use brakes until the nose is on the runway.

NOTE

Landing light may not be usable with nose gear in unsafe condition.

12. Before landing checklist – Complete.

AFTER TOUCHDOWN:

13. **POWER** levers – **IDLE**.

14. **PROP** levers – **FEATHER**.

15. **CONDITION** levers – **FUEL CUTOFF**.

AFTER STOPPING:

16. Fuel **FIREWALL SHUTOFF VALVES – CLOSED**.

17. **MASTER SWITCH – OFF**.

NOTE

If landing is to be performed at night, the pilot may elect to turn on the baggage compartment light or other cabin lighting to assist in aircraft evacuation. If cabin lighting is desired, leave the MASTER SWITCH ON. The baggage compartment light is wired directly to the battery and will illuminate with the MASTER SWITCH OFF.

e. Landing With One Main Gear Unsafe. If one main landing gear fails to extend, retract the other gear and make a gear-up landing. If the gear cannot be retracted, land the aircraft on a hard surface runway, touching down on the same edge of the runway as the extended gear. Roll on the down and locked gear, holding the opposite wing up and the nose wheel straight as long as possible. If the gear has extended, but is unsafe, apply brakes lightly on the unsafe side to assist in locking the gear. If the gear has not extended or does not lock, allow the wing to lower slowly to the runway. Use the following procedure:

1. Retract gear and make a **GEAR UP LANDING**.

IF THE GEAR WILL NOT RETRACT:

2. Fuel load – Reduce.
3. Crew and passenger briefings – Complete.
4. Loose equipment – Stow/secure.
5. **BLEED AIR VALVES** – **ENVIR OFF** (below 10,000 feet).
6. Cabin pressure switch – **DUMP** (after cabin has depressurized).

WARNING

Prior to removing the emergency exit hatch, slow to a safe airspeed, approximately 160 KIAS or below, and ensure passengers are seated with seat belts fastened and all loose equipment secured.

7. Emergency exit hatch – Remove and secure.
8. Seat belts and harnesses – Fasten.
9. Extension handle – Stow.
10. **LDG GEAR CONTROL** – **DN**.
11. **LANDING GEAR RELAY** circuit breaker – Pull.
12. **LANDING GEAR WARN** horn circuit breaker – Pull.
13. Nonessential electrical equipment – Off.
14. Before landing checklist – Complete.
15. **FLAPS** – As required.
16. Airspeed – Normal approach speed.
17. **POWER** levers – **IDLE** when landing on the desired touchdown area is assured.
18. **CONDITION** levers – **FUEL CUTOFF**.

AFTER STOPPING:

19. Fuel **FIREWALL SHUTOFF VALVES** – **CLOSED**.
20. **MASTER SWITCH** – **OFF**.

f. Landing With Flat Tire(s). If aware that a main gear tire(s) is flat, a landing close to the edge of the runway opposite the flat tire will help avoid veering off the runway. If the nose wheel tire is flat, use minimum braking.

9-31. LANDING WITH INOPERATIVE WING FLAPS (UP).

The aircraft does not exhibit any unusual characteristics when landing with the flaps up. The approach angle will be shallow and the touchdown speed will be higher, resulting in a longer landing roll.

9-32. CRACKED WINDSHIELD.

a. External Crack In-flight. If an external windshield crack is noted, no action is required in flight.

NOTE

Heating elements may be inoperative in areas of crack.

b. Internal Crack In-flight. If it is determined that an internal crack has occurred in flight, perform the following:

1. Descend – Below 25,000 feet.
2. Cabin pressure – Reset pressure differential to maintain 4.0 psi or less as required.

9-33. CRACKED CABIN WINDOW.

If crack(s) in a cabin window ply(s) occurs in flight, perform the following:

1. Crew oxygen masks – **100%** and on (if above 10,000 feet).
2. **CABIN** signs switch – **NO SMOKE & FSB**.
3. Passenger oxygen – On and checked (if above 10,000 feet). The copilot should confirm that all passengers have oxygen masks on and are receiving supplemental oxygen if required.
4. Cabin pressure – Depressurize.

5. Land as soon as practicable. If a cabin window has developed a crack, the aircraft shall not be flown once landed, without proper ferry flight authorization.

9-34. DITCHING.

If a decision to ditch is made, immediately alert all personnel to prepare for ditching. Plan the approach into the wind if the wind is high and the seas are heavy. If the swells are heavy but the wind is light, land parallel to the swells. Set up a minimum rate descent (power on or off, as the situation dictates – airspeed 110 – 120 KIAS). Flare as in a normal landing, as it is very difficult to judge altitude over water, particularly in a slick sea. Leveling off too high may cause a nose low "drop-in," while having the tail too low at impact may result in the aircraft pitching forward and "digging-in." Expect more than one impact shock and several skips before the final hard shock. There may be nothing but spray visible for several seconds while the aircraft is decelerating. To prevent cartwheeling, it is important that the wings be level when the aircraft hits the water. After the aircraft is at rest, supervise evacuation of passengers and exit the aircraft as quickly as possible. In a planned ditching, the life raft and first-aid kits should be secured close to the cabin emergency exit hatch for easy access when evacuating; however, do not remove the raft from its carrying case inside the aircraft. After exiting the aircraft, keep the raft from any damaged surfaces that might tear or puncture the fabric. The length of time that the aircraft will float depends on the fuel level and the extent of aircraft damage caused by the ditching. Table 9-1 lists the appropriate duties for crew and occupants for planned and immediate ditching. Refer to Figure 9-3 for body positions during ditching. Figure 9-4 shows sea swell information. Perform the following procedure:

WARNING

Do not unstrap from the seat until all motion stops. Do not attempt evacuation until the aircraft comes to a complete stop due to the possibility of injury and disorientation.

1. Radio calls/transponder – As required.
2. Personnel emergency briefing – As required.
3. **BLEED AIR VALVES** – **PNEU** & **ENVIR OFF**.
4. **CABIN PRESS** switch – **DUMP**.
5. **CABIN** signs switch – **NO SMOKE & FSB**.
6. Cabin emergency exit hatch – Remove and stow.
7. Seat belts and harnesses – Secure.
8. **GEAR** – **UP**.
9. **FLAPS** – **DOWN**.
10. Nonessential electrical equipment – Off.
11. Approach – Normal, power on.
12. Emergency lights – As required.

9-35. FLIGHT CONTROLS MALFUNCTION.

Use the following procedures, as applicable, for flight control malfunctions.

a. Unscheduled Rudder Boost Activation. Rudder boost operation without a large variation of power between engines indicates a failure of the system. Perform the following:

1. **RUDDER BOOST** – **OFF.**

NOTE

The rudder boost system may not operate when the brake deice system is in use. Availability of the rudder boost system will be restored to normal when the BRAKE DEICE switch is turned OFF.

IF CONDITION PERSISTS:

2. **RUDDER BOOST** circuit breaker – Pull.
3. **BLEED AIR VALVE** – **OFF** (below 10,000 feet).
4. Rudder trim – Adjust.

b. Unscheduled Electric Elevator Trim. In the event of unscheduled electric elevator trim, perform the following:

1. Control wheel disconnect switch – Press fully.
2. Elevator trim switch – **OFF**.
3. **AP TRIM POWER** circuit breaker – Out.

CAUTION

Do not attempt to free a frozen trim tab by activating either the electric trim or manual trim controls. The force required to break the ice will probably exceed the force that can be delivered to the hinge-line by either electric or manual controls. Over stressing the trim tab cable circuit or the electric drive unit could damage either or both.

c. Electric Elevator Trim Controls Frozen in Flight. Moisture entering or condensing in the elevator trim control clutch assembly can freeze in flight locking the trim in a cruise position. This condition is first noticed when preparing for descent or retrimming at altitude. Flight in above freezing temperatures will normally clear the problem before landing, however if the elevator control is still frozen during the approach, control forces must be overcome manually. Descend using power reduction to keep heavy control forces caused by airspeed increases to a minimum. If trim control freedom has not been attained prior to landing, consider a no flaps approach and landing to ease control back pressure.

9-36. ELECTROTHERMAL PROPELLER DEICE (AUTO SYSTEM) MALFUNCTION.

Abnormal Reading on Deice Ammeter (normal operation 18 to 24 amps).

ZERO AMPS:

1. **PROP** deice switch – Check **AUTO**.

IF AMPS REMAIN AT ZERO:

2. **PROP** deice switch – **OFF** (for 30 seconds).
3. **PROP** deice switch – **AUTO**.

IF AMPS REMAIN AT ZERO:

4. Manual backup system – Initiate. (Refer to Electrothermal Propeller Deice Manual System Operation, Paragraph 9-37.)

BELOW 18 AMPS:

5. Operation – Continue.
6. RPM – Increase (briefly to aid in ice removal if propeller imbalance occurs).

OVER 24 AMPS:

7. Monitor – Continue operation if the **PROP** deice circuit breaker switch does not trip.
8. RPM – Increase (briefly to aid in ice removal if propeller imbalance occurs).
9. Loadmeter – Monitor for excessive current drain. If the **PROP AUTO** deice circuit breaker switch trips, use the manual system.
10. If the **PROP AUTO** deice control circuit breaker or the left or right prop deice circuit breaker trips, avoid icing conditions.

9-37. ELECTROTHERMAL PROPELLER DEICE MANUAL SYSTEM OPERATION.

1. Manual propeller deice switch – Hold in **MANUAL** position for approximately 90 seconds, or until ice is dislodged from blades.
2. Manual system current requirement – Monitor the aircraft's loadmeters when the manual deice switch is in the **MANUAL** position. A small needle deflection (approximately 5%) indicates the system is functioning.

Table 9-1. Ditching

PLANNED DITCHING	IMMEDIATE DITCHING
PILOT	PILOT
A. ALERT OCCUPANTS	A. WARN OCCUPANTS
B. ORDER TO PREPARE SURVIVAL GEAR FOR AERIAL DROP	B. TRANSMIT DISTRESS MESSAGE
C. TRANSMIT DISTRESS MESSAGE	C. LIFE VEST – CHECK (DO NOT INFLATE)
D. LIFE VEST – CHECK (DO NOT INFLATE)	D. APPROACH – NORMAL

Table 9-1. Ditching

PLANNED DITCHING	IMMEDIATE DITCHING
PILOT	**PILOT**
E. DISCHARGE MARKER	E. NOTIFY OCCUPANTS TO BRACE FOR DITCHING
F. DITCH AIRCRAFT	F. DITCH AIRCRAFT
G. ABANDON AIRCRAFT	G. ABANDON AIRCRAFT AFTER COPILOT THROUGH CABIN EMERGENCY HATCH
COPILOT	**COPILOT**
A. REMOVE CABIN EMERGENCY HATCH	A. REMOVE CABIN EMERGENCY HATCH
B. LIFE VEST – CHECK (DO NOT INFLATE)	B. LIFE VEST – CHECK (DO NOT INFLATE)
C. ABANDON AIRCRAFT (TAKE LIFE RAFT AND FIRST AID KIT)	C. ABANDON AIRCRAFT (TAKE LIFE RAFT AND FIRST AID KIT)
PASSENGERS	**PASSENGERS**
A. SEAT BELTS – FASTEN	A. SEAT BELTS – FASTEN
B. LIFE VEST – CHECK (DO NOT INFLATE)	B. LIFE VEST – CHECK (DO NOT INFLATE)
C. ON PILOTS SIGNAL – BRACE FOR DITCHING	C. ON PILOTS SIGNAL – BRACE FOR DITCHING
D. ABANDON AIRCRAFT THROUGH CABIN DOOR (TAKE LIFE RAFT AND FIRST AID KIT)	D. ABANDON AIRCRAFT THROUGH CABIN DOOR (TAKE LIFE RAFT AND FIRST AID KIT)

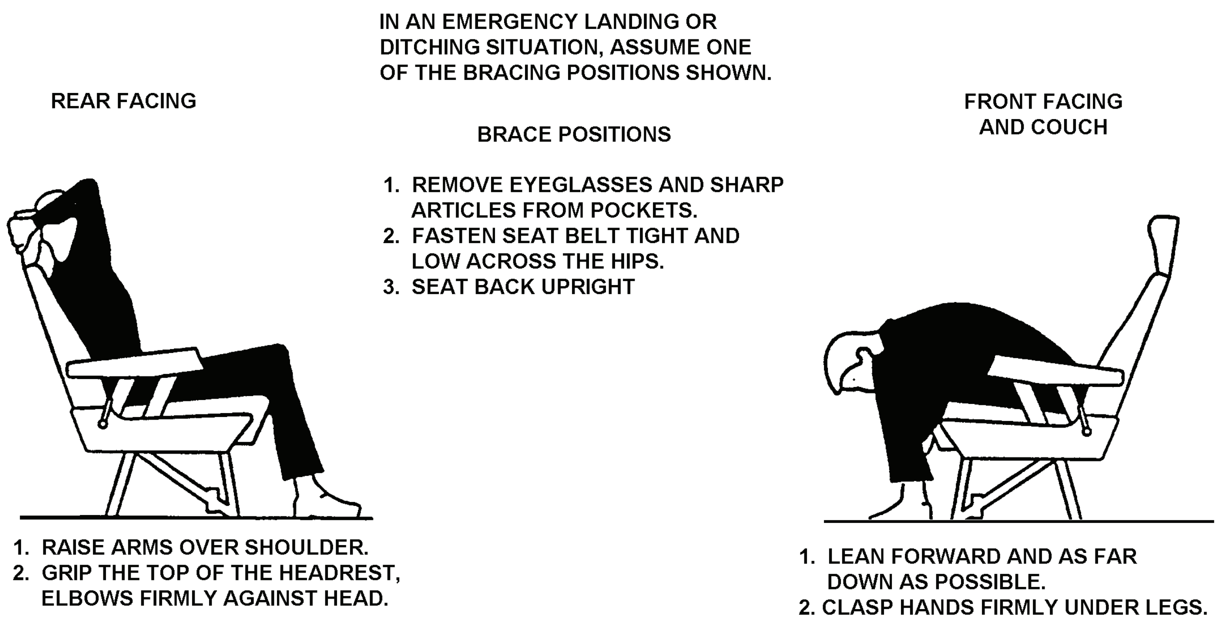


Figure 9-3. Emergency Body Positions

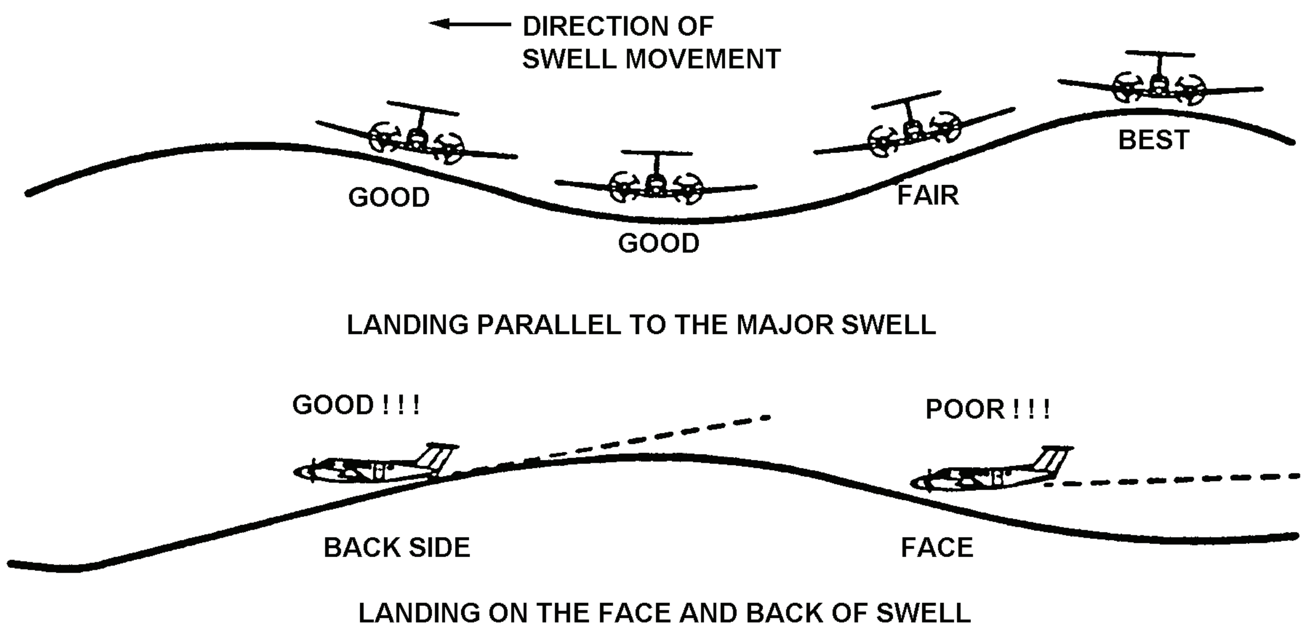


Figure 9-4. Wind Swell Ditch Heading Evaluation

APPENDIX A
REFERENCES

AR 70 –50	Designating And Naming Defense Equipment, Rockets, And Guided Missiles
AR 95-1	Army Aviation – General Provisions And Flight Regulations
AR 385-40	Accident Reporting And Records
DA PAM 738-751	Functional User's Manual For The Army Maintenance Management System – Aviation (TAMMS-A)
FAR PART 91	Federal Aviation Regulation, General Operating And Flight Rules
FM 1-230	Meteorology For Army Aviators
FM 1-240	Instrument Flying And Navigation For Army Aviators
TC1-218	Aircrew Training Manual (ATM)
TM 1-1510-225-CL	Operator's And Crewmember's Checklist, Army Model C-12R Aircraft, C-12T3 Aircraft, C-12F3 Aircraft
TM 55-1500-204-25/1	General Aircraft Maintenance Manual
TM 55-1500-342-23	Army Aviation Maintenance Manual – Weight And Balance
TM 750-244-1-5	Procedures For The Destruction Of Aircraft And Associated Equipment To Prevent Enemy Use

APPENDIX B
ABBREVIATIONS AND TERMS

For the purpose of this manual, the following abbreviations and terms apply. See appropriate technical manuals for additional terms and limits:

B-1. AIRSPEED TERMINOLOGY

CAS	Calibrated airspeed is indicated airspeed corrected for position and instrument error.
GS	Ground speed is the speed of the aircraft relative to the ground
IAS	Indicated airspeed is the speed as shown on the airspeed indicator and assumes no instrument error
KTS	Knots
M	Mach number. The ratio of true airspeed to the speed of sound.
M_{mo}	Maximum operating Mach number. M_{mo} varies with altitude.
TAS	True airspeed is calibrated airspeed corrected for altitude, temperature, pressure, and compressibility effects
V_1	Takeoff decision speed. The maximum speed below which the pilot must initiate the first action (brake application) to discontinue the takeoff. Above V_1, the takeoff must be continued.
V_2	Takeoff Safety Speed. Must be attained at 35 feet above the runway and is the speed to be maintained during climb to clear an obstacle
V_a	Maneuvering speed is the maximum speed at which application of full available aerodynamic control will not overstress the aircraft.
V_{enr}	One engine inoperative enroute climb speed with the remaining engine at maximum continuous power setting for the condition, landing gear and flaps retracted.
V_f	Design flap speed is the highest speed permissible at which wing flaps may be actuated.
V_{fe}	Maximum flap extended speed is the highest speed permissible with wing flaps in a prescribed extended position.
V_{le}	Maximum landing gear extended speed is the maximum speed at which an aircraft can be safely flown with the landing gear extended.
V_{lo}	Maximum landing gear operating speed is the maximum speed at which the landing gear can be safely extended or retracted.
V_{mca}	The minimum flight speed at which the aircraft is directionally controllable as determined in accordance with Federal Aviation Regulations. Aircraft Certification conditions include one engine becoming inoperative and propeller windmilling; up to a 5° bank toward the operative engine; takeoff power on operative engine; landing gear up; flaps up; and most rearward CG. This speed has been demonstrated to provide satisfactory control above power off stall speed (which varied with weight, configuration, and flight attitude).
V_{mcg}	Ground minimum control speed.
V mo	Maximum operating limit speed. Not deliberately exceeded in any phase of flight (climb, cruise, descent) unless a higher speed is specifically authorized for flight test or pilot training.
V_{ne}	Never exceed speed.
V_r	Rotation speed. The speed at which aircraft rotation is initiated. Varies with weight, altitude, and temperature.
V_{ref}	The indicated airspeed that the aircraft should be at when 50 feet above the runway in the landing configuration.
V_s	Power off stalling speed or the minimum steady flight speed at which the aircraft is controllable.

V_{so}	Stalling speed or the minimum steady flight speed in the landing configuration.
V_{sse}	The safe one-engine inoperative speed selected to provide a reasonable margin against the occurrence of an unintentional stall when making intentional engine cuts.
V_{yse}	The best single-engine rate-of-climb speed is the airspeed which delivers the greatest gain of altitude in the shortest possible time with one engine inoperative, gear and flaps up.

B-2. METEOROLOGICAL TERMINOLOGY

Altimeter Setting	Barometric pressure corrected to sea level.
°C	Degrees Celsius.
°F	Degrees Fahrenheit.
FAT	Free air temperature is the free air static temperature, obtained either from ground meteorological sources or from in-flight temperature indications adjusted for compressibility effects.
Indicated Pressure Altitude	The number actually read from an altimeter when the barometric scale (Kollsman window) has been set to 29.92 inches of mercury (1013 millibars).
ISA	International Standard Atmosphere in which: The air is a dry perfect gas. The temperature at sea level is 59 °F, 15 °C. The pressure at sea level is 29.92 inches Hg. The temperature gradient is -0.003566 °F per foot from sea level to the altitude at which the temperature is –69.7 °F, and 0° above that altitude.
Pressure Altitude	Indicated pressure altitude corrected for altimeter error.
SL	Sea level.
Wind	The wind velocities recorded as variables on the charts of this manual are to be understood as the headwind or tailwind components of the actual winds at 50 feet above runway surface (tower winds).

B-3. POWER TERMINOLOGY

Beta Range	The region of the **POWER** lever control which is aft of the **IDLE** stop and forward of reversing range where blade pitch angle can be changed without changing gas generator speed.
Cruise Climb	The maximum power approved for normal climb. This power is torque or temperature (ITT) limited.
GROUND FINE	The region of the **POWER** lever control, which is aft of the **IDLE** stop and forward of **REVERSE** range, where propeller blade pitch angle and gas generator RPM can be changed. Use to provide deceleration on the ground during landing accelerate-stop conditions.
HIGH IDLE	The region of **CONDITION** lever control placarded as the **HIGH IDLE** position. This limits the power operation to a minimum of 70% of N_1 RPM.
LOW IDLE	The region of **CONDITION** lever control placarded as the **LOW IDLE** position. This limits the power operation to a minimum of 62% of N_1 RPM.
Maximum Cruise Power	The highest power rating for cruise that is not time limited.
Maximum Continuous Power	The maximum power available from an engine for use during an emergency operation.
Normal Rated Climb Power	The maximum power available from an engine for continuous normal climb operations.
Normal Rated Power	The maximum power available from an engine for continuous operation in cruise (with lower ITT limit than normal rated climb power).

Reverse Thrust	The region of the **POWER** lever control that is aft of the Beta and **GROUND FINE** range and controls engine power through **GROUND FINE** and **REVERSE** range.
RPM	Revolutions Per Minute
SHP	Shaft horsepower. The horsepower imparted to the propeller shaft.
Static Power	The power which must be available for takeoff without exceeding engine limitations.
Takeoff Power	The maximum power permissible for a takeoff.

B-4. CONTROL AND INSTRUMENT TERMINOLOGY

CONDITION Lever (Fuel Shut-off Lever)	The fuel shut-off lever actuates a valve in the fuel control unit that controls the flow of fuel at the fuel control outlet and regulates the **IDLE** range from **LOW** to **HIGH**.
N_1 Tachometer (Gas Generator RPM)	The tachometer registers the RPM of the gas generator with 100% representing a gas generator speed of 37,500 RPM.
POWER Lever (Gas Generator N_1 RPM)	The **POWER** lever serves to modulate engine power from full reverse thrust to takeoff. The position for **IDLE** represents the lowest recommended level of power for flight operation.
Propeller Control Lever (N_2 RPM)	The propeller control lever is used to control the RPM setting of the propeller governor. Movement of the lever results in an increase of decrease in propeller RPM. Propeller feathering is the result of lever movement beyond the detents at the low RPM (high pitch) end of the lever travel.
Propeller Governor	The propeller governor senses changes in RPM and hydraulically changes propeller blade angle to compensate for the changes in RPM. Constant propeller RPM is thereby maintained at the selected RPM setting.
Torque-meter	The torquemeter system determines the shaft output torque. Torque values are obtained by tapping into two outlets on the reduction gear case and recording the differential pressure from the outlets.
Interstage Turbine Temperature (ITT)	The temperature of the gases present between the compressor turbine and power turbine.

B-5. GRAPH AND TABULAR TERMINOLOGY

AGL	Above ground level
Best Angle-of-Climb	The best angle-of-climb speed is the airspeed that delivers the greatest gain of altitude in the shortest possible horizontal distance with gear and Flaps up.
Best Rate-of-Climb	The best rate-of-climb speed is the airspeed that delivers the greatest gain of altitude in the shortest possible time with gear and flaps up.
Clean Configu-ration	Gear and **FLAPS UP**.
Demon-strated Crosswind	The maximum 90° crosswind component for which adequate control of the aircraft during takeoff and landing was actually demonstrated during certification tests.
Gradient	The ratio of the change in height to the horizontal distance, usually expressed in percent.
Landing Weight	The weight of the aircraft at landing touchdown.
Maximum Zero Fuel Weight	Any weight above the value given must be loaded as fuel.
MEA	Minimum Enroute Altitude
Ramp Weight	The gross weight of the aircraft before engine start. Included is the takeoff weight plus a fuel allowance for start, taxi, run-up and take-off ground roll to lift-off.
Route Segment	A part of a route. Each end of that part is identified by a geographic location or a point at which a definite radio fix can be established.

Service Ceiling	The altitude at which the maximum rate-of-climb of 100 fpm can be attained for existing aircraft weight.
Takeoff Weight	The weight of the aircraft at lift-off from the runway.

B-6. WEIGHT AND BALANCE TERMINOLOGY

Approved Loading Envelope	Those combinations of aircraft weight and center of gravity that define the limits beyond which loading is not approved.
Arm	The distance from the center of gravity of an object to a line about which moments are to be computed.
Basic Empty Weight	The aircraft weight with fixed ballast, unusable fuel, engine oil, engine coolant, hydraulic fluid, and in other respects as required by applicable regulatory standards.
Center of Gravity (CG)	A point at which the weight of an object may be considered concentrated for weight and balance purposed.
CG Limits	CG limits are the extremes of movement that the CG can have without making the aircraft unsafe to fly. The CG of the loaded aircraft must be within these limits at takeoff, in the air, and on landing.
Datum	A vertical plane perpendicular to the aircraft longitudinal axis from which fore and aft (usually aft) measurements are made for weight and balance purposes.
Engine Oil	That portion of the engine oil that can be drained from the engine.
Landing Weight	The weight of the aircraft at landing touchdown.
Maximum Weight	The largest weight allowed by design, structural, performance or other limitations.
Maximum Zero Fuel Weight	Any weight above the value must be loaded as fuel.
Moment	A measure of the rotational tendency of a weight, about a specified line, mathematically equal to the product of the weight and the arm.
Operating Weight	Basic empty weight plus crew, crew's baggage, publications, and any other equipment (not listed on Chart C) that will remain with the crew throughout the mission.
Standard	Weights corresponding to the aircraft as offered with seating and interior, avionics, accessories, fixed ballast and other equipment specified by the manufacturer as composing a standard aircraft.
Station	The longitudinal distance from some point to the zero datum or zero fuselage station.
Takeoff Weight	The weight of the aircraft at liftoff.
Unusable Fuel	The fuel remaining after consumption of usable fuel.
Usable Fuel	The portion of the total fuel load that is available for consumption as determined in accordance with applicable regulatory standards.
Useful Load	The difference between the aircraft ramp weight and basic empty weight.
Zero Fuel Weight	Operating weight plus the load equals zero fuel weight.

B-7. MISCELLANEOUS ABBREVIATIONS.

@	At
AAS	Aeronautical Advisory Service
AC	Alternating Current
ACFT	Aircraft
ACT	Active
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
AETM	Army Engine Trend Monitoring System
AFCS	Automatic Flight Control System
AFIS	Airborne Flight Information System
AGRAS	Air/Ground Radiotelephone Automated Service
ALT	Altitude
ALTSEL	Altitude Select

AM	Amplitude Modulation
ANG	Army National Guard
ANN	Annunciator
ANT	Antenna
AP, A/P	Autopilot
APRCH, APR	Approach
ARINC	Aeronautical Radio, Inc.
ARP	Airport Reference Point
ARTCC	Air Route Traffic Control Center
AS, A/S	Airspeed
ATC	Air Traffic Control
AUTO	Automatic
AUX	Auxiliary
AVGAS	Aviation Gasoline
AWOS	Automatic Weather Observing Station
BARO	Barometric
BAT, BATT	Battery
BC	Back Course, Bus Controller
BCN	Beacon
BFO	Beat Frequency Oscillator
BIT	Built-In Test
BL	Bleed
BOS	Beginning Of Stack
BOT	Bottom
BRG	Bearing
BRT	Bright
BTPS	Body Temperature And Pressure Saturated
BU	Backup, Battery Unit
CAP	Capture
CDI	Course Deviation Indicator
CDU	Control-Display Unit
CH, CHAN	Channel
CHG	Charge
CL, CKLST	Checklist
CLE	Clear Entry
CLIMB GAD	Current Aircraft Climb Performance
CLR	Clear
CMPST	Composite
COMM	Communications
COMSEC	Communications Secure
COND	Conditioning
COPLT	Copilot
CR	Cursor Return
CRS	Course
CRUISE ALT	Cruise Altitude
CTAF	Common Traffic Advisory Frequency
CVR	Cockpit Voice Recorder
CW	Continuous Wave
CWS	Control Wheel Steering
CYCL	Cycle
DB	Database
DC	Direct Current
DECR	Decrease
DEF	Default
DEG	Degrees
DEL	Delete
DEN	Density
DET	Detector
DG	Directional Gyro
DH	Decision Height
DIAG	Diagnostic
DIF	Difference
DIR	Direct
DIS	Distance
DISC	Disconnect
DISP	Display
DME	Distance Measuring Equipment
DN	Down
DR	Dear Reckoning
DTRK, DTK	Desired Track
E	East
EADI	Electronic Attitude Director Indicator

EAROM	Electronically Alterable Read Only Memory
EFIS	Electronic Flight Instrument System
EFWS	Electronic Failure Warning System
EGPWS	Enhanced Ground Proximity Warning System
EHSI	Electronic Horizontal Situation Indicator
ELEC	Electric
ELEV	Elevation
ELT	Emergency Locator Transmitter
EMERG	Emergency
ENG	Engine
ENRTE	En Route
ENVIR	Environment
EPE	Estimated Position Error
ESA	Enroute Safe Altitude
EST CROSSING	Estimated Crossing Altitude
ET	Elapsed Time
ETA	Estimated Time Of Arrival
ETA@	Estimated Time Of Arrival At Destination
ETE	Estimated Time En Route
ETM	Engine Trend Monitor
ETMS	Engine Trend Monitor System
EXP	Expired
EXT	Extinguisher, External
FAA	Federal Aviation Administration
FCU	Fuel Control Unit
FD	Flight Director
FH	Frequency Hopping
FHDG	Free Heading
FH-M	Frequency Hopping-Master
FL	Flight Level
FLIP	Flight Information Publications
FLT	Flight
FM	Frequency Modulation
FMS	Flight Management System
FOB	Fuel On Board
FPA	Flight Path Angle
FPL	Flight Plan
FPM	Feet Per Minute
FR	From Waypoint
FREQ	Frequency
FS	Fuselage Station
FSB	Fasten Seat Belt
FSS	Flight Service Station
FT	Foot, Feet
FT/MIN	Feet Per Minute
FT-LB	Foot-Pounds
G	Gravity
GA, G/A	Go-Around
GAL	Gallons
GCAS	Ground Collision Avoidance System
GEN	Generator
GLS	Glideslope System
GMAP	Ground Mapping
GMT	Greenwich Mean Time
GND	Ground
GOV	Governor
GPAAS	Ground Proximity Altitude Advisory System
GPS	Global Positioning System
GPU	Ground Power Unit
GPWS	Ground Proximity Warning System
GRI	Group Repetition Interval
GS	Glideslope
GTOW	Gross Takeoff Weight
GYRO	Gyroscope
HC	Home Cursor
HDG	Heading
HDL	Handle
HDWND	Headwind
HF	High Frequency
Hg	Mercury
HP	Holding Pattern

HR	Hours
HRZN	Horizontal
HSI	Horizontal Situation Indicator
HYD	Hydraulic
IAS	Indicated Air Speed
I/P	Identification Of Position
IC	Intercom
ICAO	International Civil Aviation Organization
IDENT	Identification
IDX	Index
IFF	Identification, Friend Or Foe
IFR	Instrument Flight Rules
IGN	Ignition
ILS	Instrument Landing System
IM	Inner Marker
IMC	Instrument Meteorological Conditions
IN	Inch
INBOUND CRS	Inbound Holding Course
INC	Increment
INCR	Increase
IND	Indicator
INF	Information
INSTR	Instrument
INTPH	Interphone
INTRPT	Interrupt
IOAT	Indicated Outside Air Temperature
IP	Identification Pulse
ITU	International Telecommunications Union
kHz	Kilohertz
KIAS	Knots Indicated Airspeed
L	Left
LB	Pounds
LC	Local Time
LDA	Localize Directional Aid
LDG	Landing
LEG DIST	Leg Distance
LH	Left Hand
LOC	Localizer
LONG	Longitude
LPM	Liters Per Minute
LSB	Lower Sideband
LT	Light
MAG	Magnetic
MAN	Manual
MAP	Missed Approach Point
MAX	Maximum
Mb	Millibars
MDA	Minimum Descent Altitude
MEM	Memory
MF	Mandatory Frequency
MFD	Multifunction Display
MHz	Megahertz
MIC	Microphone
MIN	Minimum
MKR	Marker
MM	Middle Marker
MNTR	Monitor
MPEL	Maximum Permissible Exposure Level
MPGS	Mission Planning Ground Station
MSA	Minimum Safe Altitude
MSG	Message
MSL	Mean Sea Level
N	North
NAV	Navigation
NAVAID	Navigation Aid
NDB	Non-Directional Beacon, Navigation Database
NM	Nautical Miles
NORM	Normal
NTPD	Normal Temperature And Pressure, Dry
NX	Next Waypoint
OAT	Outside Air Temperature

OBS	Omni Bearing Selector
OFST	Offset
OM	Outer Marker
OROCA	Off-Route Obstacle Clearance Altitude
OSA	Operational Support Aircraft
OVHD	Overhead
OXY	Oxygen
PC	Printed Circuit
PFD	Primary Flight Display
PGM	Program
PITCH SYNC	Pitch Synchronization
PLT	Pilot
PNEU	Pneumatic
PNL	Panel
POS	Position
#PRESL	Pre-Selected Altitude Profile Point
PRESEL ALT	Pre-Select Altitude
PRN	Pseudo Random Nose
PROP	Propeller
PRESS, PRS	Pressure
PRV	Previous
PSI	Per Square Inch
PT	Procedure Turn
PTT	Push To Talk
PVT	Private
PWR	Power
R	Right
RAD	Radial
RAIM	Receiver Autonomous Integrity Monitoring
RCL	Recall
RCV	Receiver
RDO	Radio
REC	Receiver
RECOG	Recognition
REL	Release
REM, REM@	Remaining
REQ FPM	Require Feet Per Minute
RES	Reserve
RMI	Radio Magnetic Indicator
RNAV	Area Navigation
RNG	Range
RPU	Receiver Processor Unit
RST	Reset
RT	Receiver/Transmitter
RW	Runway
S	South
SAT	Static Air Temperature
SBS	Set Beginning Of Stack
SDF	Simplified Directional Facility
SENS	Sensitivity
SF	Special Function
SHP	Shaft Horsepower
SID	Standard Instrument Departure
SMK	Smoking
SN, SNR	Signal To Noise Ratio
SPKR	Speaker
SQ	Squelch
STAR	Standard Terminal Arrival Route
STBY	Standby
STO	Store
SUA	Special Use Airspace
SUBPNL	Subpanel
SXTK	Selected Crosstrack
SYN	Synchroscope
SYNC	Synchronization
SYS	System
TACAN	Tactical Air Navigation
TAS	True Air Speed
TAT	Total Air Temperature
TBO	Time Between Overhaul

TCAS	Traffic Alert And Collision Avoidance System
TCN	Tactical Air Navigation
TCS	Touch Control Steering
TEMP	Temperature
TK	Track Angle
TLWND	Tailwind
#TOC	Top Of Climb Profile Point
#TOD	Top Of Descent Profile Point
TRANS LEVEL	Transition Level
TRI	Trip-Planning Pages
TRMNL	Terminal
TTG	Time To Go To Next Waypoint
TX	Transmit
TX CMDS	Transmit Channel Discrete
UHF	Ultra High Frequency
USB	Upper Sideband
UT	Universal Time Or Greenwich Mean Time
UTC	Coordinated Universal Time
VA	Voice Advisory
Vac	Volts, alternating current
VAR	Magnetic Variation
Vdc	Volts, direct current
VERT DEV	Vertical Deviation
VFR	Visual Flight Rules
VHF	Very High Frequency
VIP	Video Integrated Processor
VNAV	Vertical Navigation
VNVINACTV	VNAV Inactive
VOL	Volume
VOR	VHF Omni Range
VORTAC	Collocated VOR And TACAN Station
VS	Vertical Speed
VSI	Vertical Speed Indicator
W	West
WPT	Waypoint
WSHLD	Windshield
WX	Weather Radar
WXD	Radar Returns
XFR	Transfer
XMTR	Transmitter
XPDR, XPONDER	Transponder
XTK	Crosstrack
YD, Y/D	Yaw Damper

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Subject	Paragraph, Figure, Table Number

NOTE

Reminder: Chapter 3 covers avionics common to all C-12R, C-12T3, and C-12F3 model aircraft; Chapter 3A addresses C-12R-specific equipment; Chapter 3B addresses C-12T3-specific equipment; Chapter 3C addresses C-12F3-specific equipment; and Chapter 3D addresses the Global Positioning System KLN 90B for the C-12T3 and C-12F3 models.

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By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0925219

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Nowhere Town, AL 34565

PART 1 - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER: TM 9-1005-433-24

DATE: 16 Sep 2002

TITLE Organizational, Direct Support, And General Support Maintenance Manual for Machine Gun, .50 Caliber M3P and M3P Machine Gun Electrical Test Set Used On Avenger Air Defense Weapon System

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON
1	WP0005 PG 3		2			Test or Corrective Action column should identify a different WP number.

EXAMPLE

* *Reference to line numbers within the paragraph or subparagraph.*

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PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

EXAMPLE

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PUBLICATION/FORM NUMBER	DATE	TITLE

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON

* *Reference to line numbers within the paragraph or subparagraph.*

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TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

METRIC SYSTEM AND EQUIVALENTS CHART

Linear Measure	Liquid Measure
1 centimeter = 10 millimeters = .39 inches	1 centiliter = 10 milliliters = .34 fluid ounce
1 decimeter = 10 centimeters = 3.94 inches	1 deciliter = 10 centiliters = 3.38 fluid ounces
1 meter = 10 decimeters = 39.37 inches	1 liter = 10 deciliters = 33.81 fluid ounces
1 dekameter = 10 meters = 32.8 feet	1 dekaliter = 10 liters = 2.64 gallons
1 hectometer = 10 dekameters = 328.08 feet	1 hectoliter = 10 dekaliters = 26.42 gallons
1 kilometer = 10 hectometers = 3,280.8 feet	1 kiloliter = 10 hetoliters = 264.18 gallons
Weights	**Square Measure**
1 centigram = 10 milligrams = .15 grain	1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 decigram = 10 centigrams - 1.54 grains	1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 gram = 10 decigrams = .035 ounce	1 sq. meter (centare) = 100 sq. decimeter = 10.76 sq. feet
1 dekagram = 10 grams = .35 ounce	1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 hectogram = 10 dekagrams = 3.52 ounces	1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 kilogram = 10 hectograms = 2.2 pounds	1 sq. kilometer = 100 sq. hectometers = .386 sq. mile
1 quintal = 100 kilograms = 220.46 pounds	
1 metric ton = 10 quintals = 1.1 short tons	**Cubic Measure**
	1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
	1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
	1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

APPROXIMATE CONVERSION CHART

APPROXIMATE CONVERSION FACTORS

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-inches	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.496
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	1.308
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

TEMPERATURE (EXACT)

ºF	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	ºC

PIN: 076827-000